

## SAR TEST REPORT

For

**Product Name: TicWatch Pro Smartwatch**

**Brand Name: Ticwatch**

**Model No.: WF12096**

**Series Model: N/A**

**Test Report Number:**

**C180423S01-SF**

**Issued for**

**Shanghai Mobvoi Information Technology Company Limited  
Building 2-106,1690 Cailun Road,China (Shanghai) free trade area,China**

**Issued by**

**Compliance Certification Services Inc.**

**Kun Shan Laboratory**

**No.10 Weiye Rd., Innovation park, Eco&Tec,  
Development Zone, Kunshan City, Jiangsu, China**

**TEL: 86-512-57355888**

**FAX: 86-512-57370818**



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## Revision History

Revision	REPORT NO.	Date	Page Revised	Contents
Original	C180423S01-SF	May 10, 2018	N/A	N/A
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**1. CERTIFICATE OF COMPLIANCE (SAR EVALUATION)**

<b>Product Name:</b>	TicWatch Pro Smartwatch
<b>Brand Name:</b>	Ticwatch
<b>Model Name.:</b>	WF12096
<b>Series Model:</b>	N/A
<b>Device Category:</b>	PORTABLE DEVICES
<b>Exposure Category:</b>	GENERAL POPULATION/UNCONTROLLED EXPOSURE
<b>Date of Test:</b>	May 8, 2018 & May 9, 2018 & June 4, 2018
<b>Applicant:</b>	Shanghai Mobvoi Information Technology Company Limited
<b>Address:</b>	Building 2-106,1690 Cailun Road,China (Shanghai) free trade area,China
<b>Manufacturer:</b>	Shanghai Mobvoi Information Technology Company Limited
<b>Address:</b>	Building 2-106,1690 Cailun Road,China (Shanghai) free trade area,China
<b>Application Type:</b>	Certification

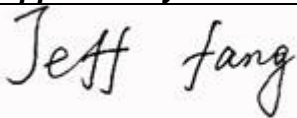
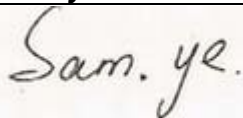
**APPLICABLE STANDARDS AND TEST PROCEDURES**

STANDARDS AND TEST PROCEDURES	TEST RESULT
ANSI/IEEE C95.1-1992 RSS102 issue 5	No non-compliance noted

**Deviation from Applicable Standard**

None

The device was tested by Compliance Certification Services Inc. in accordance with the measurement methods and procedures specified in KDB 865664; RSS102 issue 5. The test results in this report apply only to the tested sample of the stated device/equipment. Other similar device/equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

<b>Approved by:</b>	<b>Tested by:</b>
	
Jeff.fang RF Manager Compliance Certification Services Inc.	Sam.ye Test Engineer Compliance Certification Services Inc.

## 2. EUT DESCRIPTION

<b>Product Name:</b>	TicWatch Pro Smartwatch
<b>Brand Name:</b>	Ticwatch
<b>Model Name.:</b>	WF12096
<b>Series Model:</b>	N/A
<b>Model Discrepancy:</b>	N/A
<b>FCC ID:</b>	2AHEA-WF12096
<b>IC ID:</b>	21124-WF12096
<b>Hardware Version:</b>	B2.2
<b>Software Version:</b>	AW2.8
<b>Power reduction:</b>	NO
<b>DTM Description:</b>	N/A
<b>Device Category:</b>	Production unit
<b>Frequency Range:</b>	WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz Bluetooth: 2402 MHz ~ 2480 MHz
<b>Max. Reported SAR(1g):</b>	802.11g: 0.405 W/kg
<b>Extremity SAR SAR(10g):</b>	802.11g: 0.127 W/kg
<b>Modulation Technique:</b>	IEEE 802.11b: DSSS (CCK, DQPSK, DBPSK) IEEE 802.11g/n: OFDM (QPSK, BPSK, 16-QAM, 64-QAM) Bluetooth : GFSK + $\pi/4$ DQPSK+8DPSK BLE: GFSK
<b>Accessories:</b>	Battery information : Battery:3.8V 415mAh Charging Dock: Name:TicWatch Dock Model:WF20028 INPUT:DC 5V 1A OUTPUT:DC 5V 0.8A
<b>Antenna Specification:</b>	Wifi&Bluetooth: PIFA Antenna, -1 dBi
<b>Operating Mode:</b>	Maximum continuous output

## 2.1 NOMINAL AND MAXIMUM OUTPUT POWER

Mode	The Tune-up Maximum Power(Customer Declared)(dBm)
IEEE 802.11b	16.5
IEEE 802.11g	16.5
IEEE 802.11n(20M)	15.5
Bluetooth 1Mbps	7
Bluetooth 2Mbps	4
Bluetooth 3Mbps	4
BLE4.2	7

## 2.2 STATEMENT OF COMPLIANCE

The maximum results of Specific Absorption Rate (SAR) found during testing for **WF12096**, are as follows.

Equipment Class	Frequency Band	Highest SAR Summary	Highest SAR Summary
		Next-to-mouth 1g SAR (W/kg)	Wrist worn 10g SAR (W/kg)
DTS	2.4GHz WLAN	0.405	0.127
DSSS(BT)	2.4GHz	0.105	0.084
Highest Simultaneous Transmission SAR		Next-to-mouth 1g SAR (W/kg)	Wrist worn 1g SAR (W/kg)
DTS+DSSS		0.510	0.211

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 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.

### 3. REQUIREMENTS FOR COMPLIANCE TESTING DEFINED BY THE FCC

The US Federal Communications Commission has released the report and order "Guidelines for Evaluating the Environmental Effects of RF Radiation", ET Docket No. 93-62 in August 1996. The order requires routine SAR evaluation prior to equipment authorization of portable transmitter devices, including portable telephones. For consumer products, the applicable limit is 1.6 W/Kg for an uncontrolled environment and 8.0 W/Kg for an occupational/controlled environment as recommended by the ANSI/IEEE standard C95.1-1992; RSS102 issue 5.

### 4. TEST METHODOLOGY

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)
- ☒ IEEE 1528: 2013
- ☒ RSS102 issue 5
- ☒ KDB 248227 D01v02r02    802.11 Wi-Fi SAR
- ☒ KDB 447498 D01v06        General RF Exposure Guidance
- ☒ KDB 865664 D01v01r04    Measurement 100 MHz to 6 GHz
- ☒ KDB 865664 D02v01r02    RF Exposure Reporting

### 5. TEST CONFIGURATION

During WLAN SAR testing EUT is configured with the WLAN continuous TX tool, and the transmission duty factor was monitored on the spectrum analyzer with zero-span setting. For WLAN SAR testing, WLAN engineering test software installed on the EUT can provide continuous transmitting RF signal. For WLAN SAR testing, WLAN engineering test software installed on the EUT can provide continuous transmitting RF signal and the duty cycle is approximate 100%.



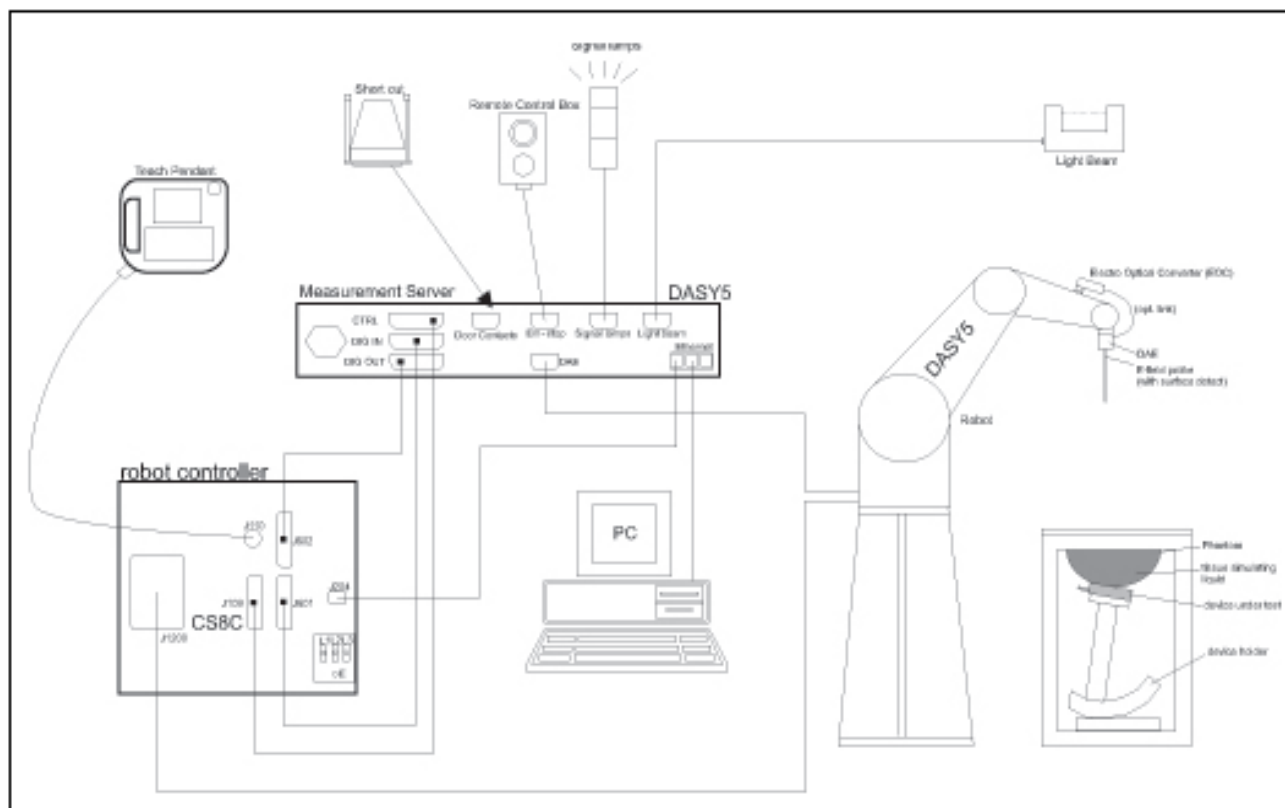
## 6. DOSIMETRIC ASSESSMENT SETUP

These measurements were performed with the automated near-field scanning system DASY 5 from SPEAG. The system is based on a high precision robot (working range greater than 0.9 m), which positions the probes with a positional repeatability of better than  $\pm 0.02$  mm. Special E- and H-field probes have been developed for measurements close to material discontinuity, the sensors of which are directly loaded with a Schottky diode and connected via highly resistive lines to the data acquisition unit. The SAR measurements were conducted with the E-field PROBE EX3DV4 (manufactured by SPEAG), designed in the classical triangular configuration and optimized for dosimetric evaluation. The probe has been calibrated according to the procedure described in [7] with accuracy of better than  $\pm 10\%$ . The spherical isotropy was evaluated with the procedure described in [8] and found to be better than  $\pm 0.25$  dB. The phantom used was the SAM Twin Phantom as described in FCC supplement C, IEEE 1528 and CENELEC EN 62209.

The following table gives the recipes for tissue simulating liquids.

Ingredients (% by weight)	Frequency (MHz)									
	450		835		915		1900		2450	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	38.56	51.16	41.45	52.4	41.05	56.0	54.9	40.4	62.7	73.2
Salt (NaCl)	3.95	1.49	1.45	1.4	1.35	0.76	0.18	0.5	0.5	0.04
Sugar	56.32	46.78	56.0	45.0	56.5	41.76	0.0	58.0	0.0	0.0
HEC	0.98	0.52	1.0	1.0	1.0	1.21	0.0	1.0	0.0	0.0
Bactericide	0.19	0.05	0.1	0.1	0.1	0.27	0.0	0.1	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.8	0.0
DGBE	0.0	0.0	0.0	0.0	0.0	0.0	44.92	0.0	0.0	26.7
Dielectric Constant	43.42	58.0	42.54	56.1	42.0	56.8	39.9	54.0	39.8	52.5
Conductivity (S/m)	0.85	0.83	0.91	0.95	1.0	1.07	1.42	1.45	1.88	1.78

## 6.1 MEASUREMENT SYSTEM DIAGRAM



**The DASYS5 system for performing compliance tests consists of the following items:**

- A standard high precision 6-axis robot (Stäubli RX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
- 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 between optical and electrical of the signals for the digital communication to the DAE and for the analog signal from the optical surface detection. The EOC is connected 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.
- A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
- A computer operating Windows 7.
- DASYS5 software.
- Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- The SAM twin phantom enabling testing left-hand and right-hand usage.
- The device holder for handheld mobile phones.
- Tissue simulating liquid mixed according to the given recipes.
- Validation dipole kits allowing validating the proper functioning of the system.

## 6.2 SYSTEM COMPONENTS



The DASY5 measurement server is based on a PC/104 CPU board with a 400MHz intel ULV celeron, 128MB chip-disk and 128 MB RAM. The necessary circuits for communication with either the DAE4(or DAE3) electronic box as well as the 16-bit AD-converter system for optical detection and digital I/O interface are contained on the DASY5 I/O-board, which is directly connected to the PC/104 bus of the CPU board.

The measurement server performs all real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operation.



The PC-operating system cannot interfere with these time critical processes. All connections are supervised by a watchdog, and disconnection of any of the cables to the measurement server will automatically disarm the robot and disable all program-controlled robot movements. Furthermore, the measurement server is equipped with two expansion slots which are reserved for future applications. Please note that the expansion slots do not have a standardized pinout and therefore only the expansion cards provided by SPEAG can be inserted. Expansion cards from any other supplier could seriously damage the measurement server. Calibration: No calibration required.

### Data Acquisition Electronics (DAE)



The data acquisition electronics (DAE4) 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 mechanical probe mounting device includes two different sensor systems for frontal and sideways probe contacts. They are used for mechanical surface detection and probe collision detection. The input impedance of the DAE4 box is 200M $\Omega$ ; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

### EX3DV4 Isotropic E-Field Probe for Dosimetric Measurements



**Construction:** Symmetrical design with triangular core  
Built-in shielding against static charges  
PEEK enclosure material (resistant to organic solvents, e.g., DGBE)

**Calibration:** Basic Broad Band Calibration in air: 10-3000 MHz.  
Conversion Factors (CF) for HSL 900 and HSL 1800  
CF-Calibration for other liquids and frequencies upon request.

**Frequency:** 10 MHz to > 6 GHz; Linearity:  $\pm 0.2$  dB (30 MHz to 3 GHz)

**Directivity:**  $\pm 0.3$  dB in HSL (rotation around probe axis)  
 $\pm 0.5$  dB in HSL (rotation normal to probe axis)

**Dynamic Range:** 10  $\mu$ W/g to > 100 mW/g; Linearity:  $\pm 0.2$  dB  
(noise: typically < 1  $\mu$ W/g)

**Dimensions:** Overall length: 337 mm (Tip: 9 mm)  
Tip diameter: 2.5 mm (Body: 10 mm)  
Distance from probe tip to dipole centers:  
1 mm

**Application:** High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better 30%.



Interior of probe

## SAM Twin Phantom

### Construction:

The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528-200X, CENELEC 50360 and IEC 62209. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points with the robot.

**Shell Thickness:**  $2 \pm 0.2$  mm

**Filling Volume:** Approx. 25 liters

**Dimensions:** Height: 850mm; Length: 1000mm; Width: 750mm



## SAM Phantom (ELI4 v4.0)

### Description Construction:

Phantom 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 the latest draft of the standard IEC 62209 Part II and all known tissue simulating liquids. ELI4 has been optimized regarding its performance and can be integrated into our standard phantom tables. A cover prevents evaporation of the liquid. Reference markings on the phantom allow installation of the complete setup, including all predefined phantom positions and measurement grids, by teaching three points. The phantom is supported by software version DASY4/DASY5.5 and higher and is compatible with all SPEAG dosimetric probes and dipoles

**Shell Thickness:**  $2.0 \pm 0.2$  mm (sagging: <1%)

**Filling Volume:** Approx. 25 liters

**Dimensions:** Major ellipse axis: 600 mm

**Minor axis:** 400 mm 500mm



**Device Holder for SAM Twin Phantom**

**Construction:** In combination with the Twin SAM Phantom, the Mounting Device (made from POM) enables the rotation of the mounted transmitter in spherical coordinates, whereby the rotation point is the ear opening. The devices can be easily and accurately positioned according to IEC, IEEE, CENELEC, FCC or other specifications. The device holder can be locked at different phantom locations (left head, right head, and flat phantom).

**System Validation Kits for SAM Twin Phantom**

**Construction:** Symmetrical dipole with 1/4 balun Enables measurement of feedpoint impedance with NWA Matched for use near flat phantoms filled with brain simulating solutions Includes distance holder and tripod adaptor.

**Frequency:** 900, 1800, 2450, 5800 MHz

**ReTune loss:** > 20 dB at specified validation position

**Power capability:** > 100 W ( $f < 1\text{GHz}$ ); > 40 W ( $f > 1\text{GHz}$ )

**Dimensions:**

D835V2: dipole length: 161 mm; overall height: 340 mm

D1800V2: dipole length: 72.5 mm; overall height: 300 mm

D1900V2: dipole length: 67.7 mm; overall height: 300 mm

D2450V2: dipole length: 51.5 mm; overall height: 290 mm

D5GHzV2: dipole length: 20.6 mm; overall height: 300mm

**System Validation Kits for ELI4 phantom**

**Construction:** Symmetrical dipole with 1/4 balun Enables measurement of feedpoint impedance with NWA Matched for use near flat phantoms filled with brain simulating solutions Includes distance holder and tripod adaptor.

**Frequency:** 900, 1800, 2450, 5800 MHz

**ReTune loss:** > 20 dB at specified validation position

**Power capability:** > 100 W ( $f < 1\text{GHz}$ ); > 40 W ( $f > 1\text{GHz}$ )

**Dimensions:**

D835V2: dipole length: 161 mm; overall height: 340 mm

D1800V2: dipole length: 72.5 mm; overall height: 300 mm

D1900V2: dipole length: 67.7 mm; overall height: 300 mm

D2450V2: dipole length: 51.5 mm; overall height: 290 mm

D5GHzV2: dipole length: 20.6 mm; overall height: 300 mm





## 7. EVALUATION PROCEDURES

### DATA EVALUATION

The DASY 5 post processing software automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software:

Probe parameters:	- Sensitivity	$Norm_i, a_{i0}, a_{i1}, a_{i2}$
	- Conversion factor	$ConvF_i$
	- Diode compression point	$dcp_i$
Device parameters:	- Frequency	$f$
	- Crest factor	$cf$
Media parameters:	- Conductivity	$\sigma$
	- Density	$\rho$

These parameters must be set correctly in the software. They can be found in the component documents or be imported into the software from the configuration files issued for the DASY 5 components. In the direct measuring mode of the multi-meter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as:

$$V_i = U_i + U_i^2 \cdot \frac{cf}{dcp_i}$$

with	$V_i$	= Compensated signal of channel i (i = x, y, z)
	$U_i$	= Input signal of channel i (i = x, y, z)
	$cf$	= Crest factor of exciting field (DASY 5 parameter)
	$dcp_i$	= Diode compression point (DASY 5 parameter)

From the compensated input signals the primary field data for each channel can be evaluated:

E-field probes:

$$E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

H-field probes:

$$H_i = \sqrt{V_i} \cdot \frac{a_{i10} + a_{i11}f + a_{i12}f^2}{f}$$

with	$V_i$	= Compensated signal of channel i (i = x, y, z)
	$Norm_i$	= Sensor sensitivity of channel i (i = x, y, z) $\mu V/(V/m)^2$ for E0field Probes
	$ConvF$	= Sensitivity enhancement in solution
	$a_{ij}$	= Sensor sensitivity factors for H-field probes
	$f$	= Carrier frequency (GHz)
	$E_i$	= Electric field strength of channel i in V/m
	$H_i$	= Magnetic field strength of channel i in A/m

The RSS value of the field components gives the total field strength (Hermitian magnitude):

$$E_{tot} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

The primary field data are used to calculate the derived field units.

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1000}$$

with  $SAR$  = local specific absorption rate in mW/g  
 $E_{tot}$  = total field strength in V/m  
 $\sigma$  = conductivity in [mho/m] or [Siemens/m]  
 $\rho$  = equivalent tissue density in g/cm<sup>3</sup>

Note that the density is normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid.

The power flow density is calculated assuming the excitation field as a free space field.

$$P_{pwe} = \frac{E_{tot}^2}{3770} \quad \text{or} \quad P_{pwe} = H_{tot}^2 \cdot 37.7$$

with  $P_{pwe}$  = Equivalent power density of a plane wave in mW/cm<sup>2</sup>  
 $E_{tot}$  = total electric field strength in V/m  
 $H_{tot}$  = total magnetic field strength in A/m

## **SAR EVALUATION PROCEDURES**

The procedure for assessing the peak spatial-average SAR value consists of the following steps:

- **Power Reference Measurement**

The reference and drift jobs are useful jobs for monitoring the power drift of the device under test in the batch process. Both jobs measure the field at a specified reference position, at a selectable distance from the phantom surface. The reference position can be either the selected section's grid reference point or a user point in this section. The reference job projects the selected point onto the phantom surface, orients the probe perpendicularly to the surface, and approaches the surface using the selected detection method.

- **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 finer measurement around the hot spot. The sophisticated interpolation routines implemented in DASY 5 software can find the maximum locations even in relatively coarse grids. The scan area is defined by an editable grid. This grid is anchored at the grid reference point of the selected section in the phantom. When the area scan's property sheet is brought-up, grid was at to 15 mm by 15 mm and can be edited by a user.

- **Zoom Scan**

Zoom scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The default zoom scan measures 5 x 5 x 7 points within a cube whose base faces are centered around the maximum found in a preceding area scan job within the same procedure. If the preceding Area Scan job indicates more than one maximum, the number of Zoom Scans has to be enlarged accordingly (The default number inserted is 1).

- **Power Drift measurement**

The drift job measures the field at the same location as the most recent reference job within the same procedure, and with the same settings. The drift measurement gives the field difference in dB from the reading conducted within the last reference measurement. Several drift measurements are possible for one reference measurement. This allows a user to monitor the power drift of the device under test within a batch process. In the properties of the Drift job, the user can specify a limit for the drift and have DASY 5 software stop the measurements if this limit is exceeded.

- **Z-Scan**

The Z Scan job measures points along a vertical straight line. The line runs along the Z-axis of a one-dimensional grid. A user can anchor the grid to the current probe location. As with any other grids, the local Z-axis of the anchor location establishes the Z-axis of the grid.



**SPATIAL PEAK SAR EVALUATION**

The procedure for spatial peak SAR evaluation has been implemented according to the IEEE1529 standard. It can be conducted for 1 g and 10 g.

The DASY 5 system allows evaluations that combine measured data and robot positions, such as:

- maximum search
- extrapolation
- boundary correction
- peak search for averaged SAR

During a maximum search, global and local maximum searches are automatically performed in 2-D after each Area Scan measurement with at least 6 measurement points. It is based on the evaluation of the local SAR gradient calculated by the Quadratic Shepard's method. The algorithm will find the global maximum and all local maxima within -2 dB of the global maxima for all SAR distributions.

**Extrapolation**

Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. Several measurements at different distances are necessary for the extrapolation.

Extrapolation routines require at least 10 measurement points in 3-D space. They are used in the Cube Scan to obtain SAR values between the lowest measurement points and the inner phantom surface. The routine uses the modified Quadratic Shepard's method for extrapolation. For a grid using 5x5x7 measurement points with 5mm resolution amounting to 343 measurement points, the uncertainty of the extrapolation routines is less than 1% for 1 g and 10 g cubes.

**Boundary effect**

For measurements in the immediate vicinity of a phantom surface, the field coupling effects between the probe and the boundary influence the probe characteristics. Boundary effect errors of different dosimetric probe types have been analyzed by measurements and using a numerical probe model. As expected, both methods showed an enhanced sensitivity in the immediate vicinity of the boundary. The effect strongly depends on the probe dimensions and disappears with increasing distance from the boundary. The sensitivity can be approximately given as:

$$S \approx S_o + S_b \exp\left(-\frac{z}{a}\right) \cos\left(\pi \frac{z}{\lambda}\right)$$

Since the decay of the boundary effect dominates for small probes ( $a \ll \lambda$ ), the cos-term can be omitted. Factors  $S_b$  (parameter Alpha in the DASY 5 software) and  $a$  (parameter Delta in the DASY 5 software) are assessed during probe calibration and used for numerical compensation of the boundary effect. Several simulations and measurements have confirmed that the compensation is valid for different field and boundary configurations.

This simple compensation procedure can largely reduce the probe uncertainty near boundaries. It works well as long as:

- the boundary curvature is small
- the probe axis is angled less than 30° to the boundary normal
- the distance between probe and boundary is larger than 25% of the probe diameter
- the probe is symmetric (all sensors have the same offset from the probe tip)

Since all of these requirements are fulfilled in a DASY 5 system, the correction of the probe boundary effect in the vicinity of the phantom surface is performed in a fully automated manner via the measurement data extraction during post processing.

**8. MEASUREMENT UNCERTAINTY**

Measurement uncertainty for 30 MHz to 3 GHz averaged over 1 gram

Uncertainty Component	Uncertainty	Prob.	Div.	$C_i(1g)$	Std. Unc. (1-g)	$V_i$ or $V_{eff}$
<b>Measurement System</b>						
Probe Calibration ( $k=1$ )	5.50	Normal	1	1	5.50	$\infty$
Probe Isotropy	4.70	Rectangular	$\sqrt{3}$	0.7	1.90	$\infty$
Modulation Response	2.40	Rectangular	$\sqrt{3}$	1	1.39	$\infty$
Hemispherical Isotropy	9.60	Rectangular	$\sqrt{3}$	0.7	3.88	$\infty$
Boundary Effect	1.00	Rectangular	$\sqrt{3}$	1	0.58	$\infty$
Linearity	4.70	Rectangular	$\sqrt{3}$	1	2.71	$\infty$
System Detection Limit	1.00	Rectangular	$\sqrt{3}$	1	0.58	$\infty$
Readout Electronics	0.30	Normal	1	1	0.30	$\infty$
Response Time	0.80	Rectangular	$\sqrt{3}$	1	0.46	$\infty$
Integration Time	2.60	Rectangular	$\sqrt{3}$	1	1.50	$\infty$
RF Ambient Noise	3.00	Rectangular	$\sqrt{3}$	1	1.73	$\infty$
RF Ambient Reflections	3.00	Rectangular	$\sqrt{3}$	1	1.73	$\infty$
Probe Positioner	0.40	Rectangular	$\sqrt{3}$	1	0.23	$\infty$
Probe Positioning	2.90	Rectangular	$\sqrt{3}$	1	1.67	$\infty$
Max. SAR Evaluation	2.00	Rectangular	$\sqrt{3}$	1	1.15	$\infty$
<b>Test sample Related</b>						
Test sample Positioning	2.9	Normal	1	1	2.9	145
Device Holder Uncertainty	3.6	Normal	1	1	3.6	5
Power drift	5	Rectangular	$\sqrt{3}$	1	2.89	$\infty$
Power Scaling	0	Rectangular	$\sqrt{3}$	1	0.00	$\infty$
<b>Phantom and Tissue Parameters</b>						
Phantom Uncertainty	6.1	Rectangular	$\sqrt{3}$	1	3.52	$\infty$
SAR correction	1.9	Rectangular	$\sqrt{3}$	1	1.10	$\infty$
Liquid Conductivity (target)	5	Rectangular	$\sqrt{3}$	0.64	1.85	$\infty$
Liquid Conductivity (meas)	-2.13	Rectangular	$\sqrt{3}$	0.78	-0.96	$\infty$
Liquid Permittivity (target)	5	Rectangular	$\sqrt{3}$	0.6	1.73	$\infty$
Liquid Permittivity (meas)	-3.7	Rectangular	$\sqrt{3}$	0.26	-0.56	$\infty$
Temp. unc. - Conductivity	3.4	Rectangular	$\sqrt{3}$	0.78	1.53	$\infty$
Temp. unc. - Permittivity	0.4	Rectangular	$\sqrt{3}$	0.23	0.05	$\infty$
<b>Combined Std. Uncertainty</b>		RSS			11.18	361
<b>Expanded STD Uncertainty</b>		$k=2$			22.35%	

## Measurement uncertainty for 30 MHz to 3 GHz averaged over 10 gram

Uncertainty Component	Uncertainty	Prob.	Div.	$C_i(10g)$	Std. Unc.(10-g)	$V_i$ or $V_{eff}$
<b>Measurement System</b>						
Probe Calibration ( $k=1$ )	5.50	Normal	1	1	5.50	$\infty$
Probe Isotropy	4.70	Rectangular	$\sqrt{3}$	0.7	1.90	$\infty$
Modulation Response	2.40	Rectangular	$\sqrt{3}$	1	1.39	$\infty$
Hemispherical Isotropy	9.60	Rectangular	$\sqrt{3}$	0.7	3.88	$\infty$
Boundary Effect	2.00	Rectangular	$\sqrt{3}$	1	1.15	$\infty$
Linearity	4.70	Rectangular	$\sqrt{3}$	1	2.71	$\infty$
System Detection Limit	1.00	Rectangular	$\sqrt{3}$	1	0.58	$\infty$
Readout Electronics	0.30	Normal	1	1	0.30	$\infty$
Response Time	0.80	Rectangular	$\sqrt{3}$	1	0.46	$\infty$
Integration Time	2.60	Rectangular	$\sqrt{3}$	1	1.50	$\infty$
RF Ambient Noise	3.00	Rectangular	$\sqrt{3}$	1	1.73	$\infty$
RF Ambient Reflections	3.00	Rectangular	$\sqrt{3}$	1	1.73	$\infty$
Probe Positioner	0.40	Rectangular	$\sqrt{3}$	1	0.23	$\infty$
Probe Positioning	2.90	Rectangular	$\sqrt{3}$	1	1.67	$\infty$
Max. SAR Evaluation	2.00	Rectangular	$\sqrt{3}$	1	1.15	$\infty$
<b>Test sample Related</b>						
Test sample Positioning	2.9	Normal	1	1	2.9	145
Device Holder Uncertainty	3.6	Normal	1	1	3.6	5
Power drift	5	Rectangular	$\sqrt{3}$	1	2.89	$\infty$
Power Scaling	0	Rectangular	$\sqrt{3}$	1	0.00	$\infty$
<b>Phantom and Tissue Parameters</b>						
Phantom Uncertainty	6.1	Rectangular	$\sqrt{3}$	1	3.52	$\infty$
SAR correction	1.9	Rectangular	$\sqrt{3}$	0.84	0.92	$\infty$
Liquid Conductivity (target)	5	Rectangular	$\sqrt{3}$	0.43	1.24	$\infty$
Liquid Conductivity (meas)	2.27	Rectangular	$\sqrt{3}$	0.71	0.93	$\infty$
Liquid Permittivity (target )	5	Rectangular	$\sqrt{3}$	0.49	1.41	$\infty$
Liquid Permittivity (meas)	-1.71	Rectangular	$\sqrt{3}$	0.26	-0.26	$\infty$
Temp. unc. - Conductivity	3.4	Rectangular	$\sqrt{3}$	0.71	1.39	$\infty$
Temp. unc. - Permittivity	0.4	Rectangular	$\sqrt{3}$	0.26	0.06	$\infty$
<b>Combined Std. Uncertainty</b>		RSS			11.04	361
<b>Expanded STD Uncertainty</b>		$k=2$			22.09%	

## 9. EXPOSURE LIMIT

(A). Limits for Occupational/Controlled Exposure (W/kg)

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

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

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

**Note:** **Whole-Body SAR** is averaged over the entire body, **partial-body SAR** is averaged over any 1 gram 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.

**Population/Uncontrolled Environments** are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure.

**Occupational/Controlled Environments** are defined as locations where there is exposure that may be incurred by people who are aware of the potential for exposure, (i.e. as a result of employment or occupation).

**NOTE**  
**GENERAL POPULATION/UNCONTROLLED EXPOSURE**  
**PARTIAL BODY LIMIT**  
**1.6 W/kg**

## 10. EUT ARRANGEMENT

Please refer to IEEE1528-2003 illustration below.

### 10.1 EUT TESTING POSITION

#### **Wrist-worn device Exposure Conditions and Front-of-face device Exposure Conditions**

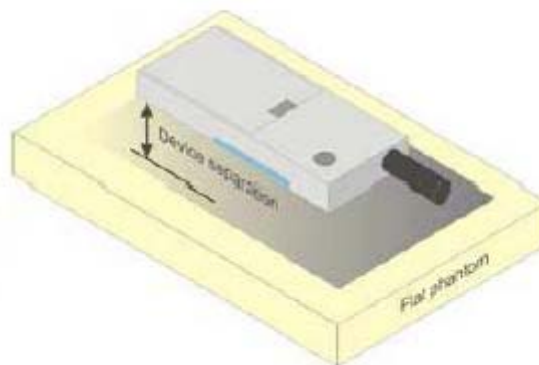
(a) Transmitters that are built-in within a wrist watch or similar wrist-worn devices typically operate in speaker mode for voice communication, with the device worn on the wrist and positioned Front-of-face. Front-of-face exposure requires 10-g SAR, and the wrist-worn condition requires 10-g extremity SAR.

(b) The 10-g extremity and 10-g SAR test exclusions may be applied to the wrist and face exposure conditions. When SAR evaluation is required, Front-of-face use is evaluated with the front of the device positioned at 10 mm from a flat phantom filled with head tissue-equivalent medium.

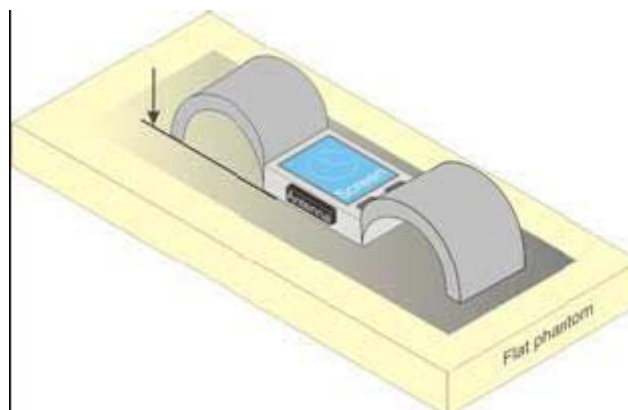
(c) For wrist-worn condition, 10g SAR value should be measured for the inner wrist band at a separation of 0mm. The design of the hard wrist band prevents opening it to a flat shape to be placed under the flat phantom.

(d) Front-of-face use is evaluated with the front of the device positioned at 10 mm from a flat phantom filled with head tissue-equivalent medium. SAR for wrist exposure is evaluated with the back of the devices positioned in direct contact against a flat phantom fill with body tissue-equivalent medium. The wrist bands should be unstrapped and touching the phantom. The space introduced by the watch or wrist bands and the phantom must be representative of actual use conditions. The 2G/3G, WIFI/BT antenna is in the watch strap, strap is fixed angle 70 angle with the plane of the Watch, removal of the plastic banding so that the EUT will fit flush against the phantom is acceptable.

The EUT has two normal use condition, they are Front-of-face device and wrist worn, and the test separation is 10mm and 0mm respectively, please see section 9.4 of EUT SETUP PHOTO



**Test position for Front-of-face**



**Test position for limb-worn**

## 11. MEASUREMENT RESULTS

### 11.1 TEST LIQUIDS CONFIRMATION

#### SIMULATED TISSUE LIQUID PARAMETER CONFIRMATION

The dielectric parameters were checked prior to assessment using the HP85070C dielectric probe kit. The dielectric parameters measured are reported in each correspondent section.

#### KDB865664 D01 RECOMMENDED TISSUE DIELECTRIC PARAMETERS

The head and Body tissue dielectric parameters recommended by the KDB865664 D01 have been incorporated in the following table.

Target Frequency (MHz)	Head		Body	
	$\epsilon_r$	$\sigma$ (S/m)	$\epsilon_r$	$\sigma$ (S/m)
150	52.3	0.76	61.9	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800-2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
3000	38.5	2.40	52.0	2.73
5800	35.3	5.27	48.2	6.00

( $\epsilon_r$  = relative permittivity,  $\sigma$  = conductivity and  $\rho = 1000 \text{ kg/m}^3$ )

**11.2 LIQUID MEASUREMENT RESULTS**

The following table show the measuring results for simulating liquid:

Liquid Type	Liquid Temp. (°C)	Parameters	Target	Measured	Deviation (%)	Limited (%)	Measured Date
Body2450	21.5	Permittivity( $\epsilon$ )	52.70	51.830	-1.65	$\pm 5$	2018-5-9
		Conductivity( $\sigma$ )	1.95	1.956	0.31	$\pm 5$	
Head2450	21.5	Permittivity( $\epsilon$ )	39.20	40.539	3.42	$\pm 5$	2018-5-8
		Conductivity( $\sigma$ )	1.80	1.764	-2.00	$\pm 5$	

Liquid Type	Liquid Temp. (°C)	Parameters	Target	Measured	Deviation (%)	Limited (%)	Measured Date
Body2462	21.5	Permittivity( $\epsilon$ )	52.68	51.784	-1.71	$\pm 5$	2018-5-9
		Conductivity( $\sigma$ )	1.97	1.966	0.00	$\pm 5$	
Head2462	21.5	Permittivity( $\epsilon$ )	39.18	40.484	3.32	$\pm 5$	2018-5-8
		Conductivity( $\sigma$ )	1.81	1.773	-2.13	$\pm 5$	

Liquid Type	Liquid Temp. (°C)	Parameters	Target	Measured	Deviation (%)	Limited (%)	Measured Date
Body2412	21.5	Permittivity( $\epsilon$ )	52.75	51.97	-1.47	$\pm 5$	2018-6-4
		Conductivity( $\sigma$ )	1.90	1.94	2.27	$\pm 5$	
Body2437	21.5	Permittivity( $\epsilon$ )	52.72	52.18	-1.02	$\pm 5$	2018-6-4
		Conductivity( $\sigma$ )	1.93	1.97	1.66	$\pm 5$	

Liquid Type	Liquid Temp. (°C)	Parameters	Target	Measured	Deviation (%)	Limited (%)	Measured Date
Head2412	21.5	Permittivity( $\epsilon$ )	39.26	37.82	-3.67	$\pm 5$	2018-6-4
		Conductivity( $\sigma$ )	1.76	1.74	-1.68	$\pm 5$	
Head2437	21.5	Permittivity( $\epsilon$ )	39.22	37.77	-3.70	$\pm 5$	2018-6-4
		Conductivity( $\sigma$ )	1.79	1.76	-1.33	$\pm 5$	

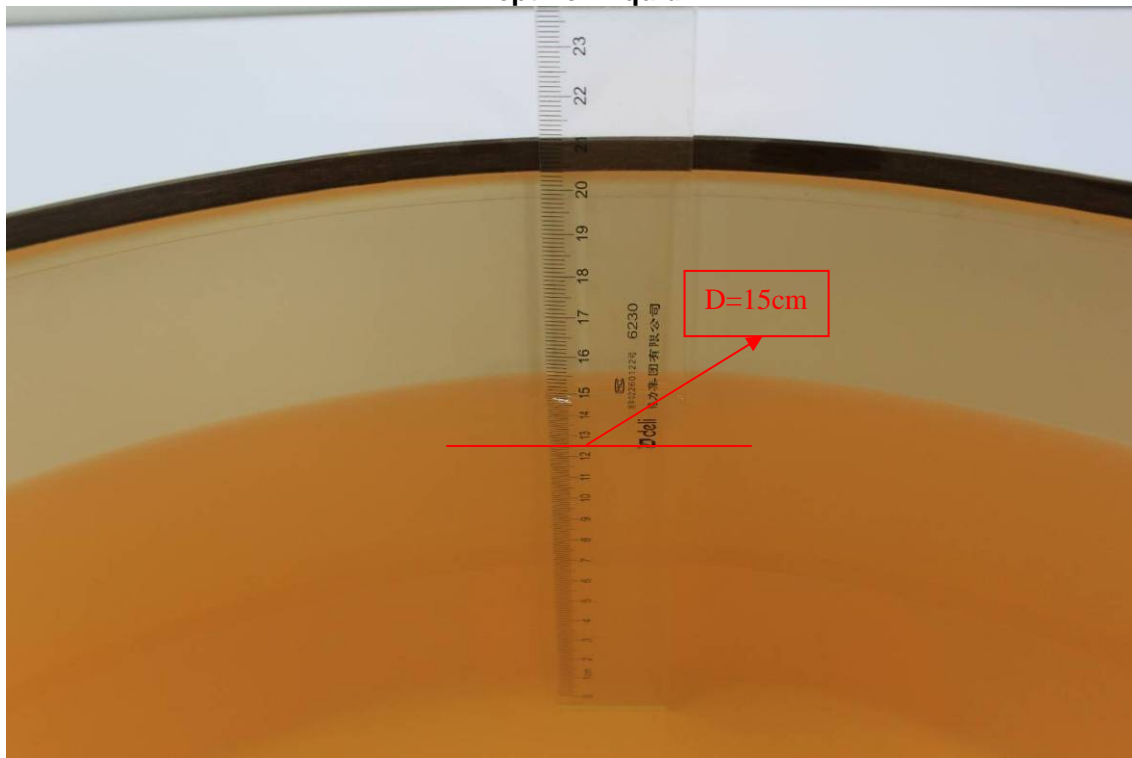
### 11.3 SYSTEM PERFORMANCE CHECK

The system performance check is performed prior to any usage of the system in order to guarantee reproducible results. The system performance check verifies that the system operates within its specifications of  $\pm 10\%$ . The system performance check results are tabulated below. And also the corresponding SAR plot is attached as well in the SAR plots files.

#### SYSTEM PERFORMANCE CHECK MEASUREMENT CONDITIONS

- The measurements were performed in the flat section of the SAM twin phantom filled with head and body simulating liquid of the following parameters.
- The DASY5 system with an E-field probe EX3DV4 SN: 3798 was used for the measurements.
- The dipole was mounted on the small tripod so that the dipole feed point was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 15 cm (above 1 GHz) from dipole center to the simulating liquid surface.
- The coarse grid with a grid spacing of 10mm was aligned with the dipole.
- Special 7x7x7 fine cube was chosen for cube integration ( $dx=5\text{ mm}$ ,  $dy=5\text{ mm}$ ,  $dz=5\text{ mm}$ ).
- Distance between probe sensors and phantom surface was set to 2 mm.
- The dipole input power was  $250\text{mW} \pm 3\%$ .
- The results are normalized to 1 W input power.

Depth of Liquid



- Note: For SAR testing, the depth is 15cm shown above



**SYSTEM PERFORMANCE CHECK RESULTS**

Liquid Type	Ambient Temp. (°C)	Liquid Temp. (°C)	Input Power (W)	Measured SAR <sub>10g</sub> (W/Kg)	1W Target SAR <sub>10g</sub> (W/Kg)	1W Normalized SAR <sub>10g</sub> (W/Kg)	Deviation (%)	Limited (%)	Date
Body2450	22	21.5	0.25	6.17	24.40	24.68	1.15	± 10	2018-5-9

Liquid Type	Ambient Temp. (°C)	Liquid Temp. (°C)	Input Power (W)	Measured SAR <sub>10g</sub> (W/Kg)	1W Target SAR <sub>1g</sub> (W/Kg)	1W Normalized SAR <sub>1g</sub> (W/Kg)	Deviation (%)	Limited (%)	Date
Head2450	22	21.5	0.25	13.00	51.70	52.00	0.58	± 10	2018-5-8

Liquid Type	Ambient Temp. (°C)	Liquid Temp. (°C)	Input Power (W)	Measured SAR <sub>10g</sub> (W/Kg)	1W Target SAR <sub>10g</sub> (W/Kg)	1W Normalized SAR <sub>10g</sub> (W/Kg)	Deviation (%)	Limited (%)	Date
Body2450	22	21.5	0.25	5.98	24.40	23.92	-1.97	± 10	2018-6-4

Liquid Type	Ambient Temp. (°C)	Liquid Temp. (°C)	Input Power (W)	Measured SAR <sub>10g</sub> (W/Kg)	1W Target SAR <sub>1g</sub> (W/Kg)	1W Normalized SAR <sub>1g</sub> (W/Kg)	Deviation (%)	Limited (%)	Date
Head2450	22	21.5	0.25	12.70	51.70	50.80	-1.74	± 10	2018-6-4

**11.4 EUT TUNE-UP PROCEDURES AND TEST MODE****WLAN 2.4G Conducted output power(dBm):**

Mode	Channel	Frequency	Average power(dBm)
802.11 b	1	2412 MHZ	14.73
	6	2437 MHZ	15.42
	11	2462 MHZ	15.61
802.11 g	1	2412 MHZ	15.17
	6	2437 MHZ	15.76
	11	2462 MHZ	16.02
802.11 n 20M	1	2412 MHZ	14.26
	6	2437 MHZ	14.93
	11	2462 MHZ	15.22

**Bluetooth Conducted output power(dBm):**

Channel	Frequency	Average power(dBm)		
		Date Rate		
		1Mbps	2Mbps	3Mbps
CH00	2402MHZ	5.12	1.68	2.16
CH39	2441MHZ	6.42	3.12	3.64
CH78	2480MHZ	6.34	3.09	3.62

**BLE 4.2 Conducted output power(dBm):**

Channel	Frequency	Average power(dBm)
		Date Rate(1Mbps)
CH00	2402MHZ	5.48
CH19	2440MHZ	6.96
CH39	2480MHZ	6.76

According to KDB447498 D01: The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at *test separation distances*  $\leq 50$  mm are determined by:

$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$  for 1-g SAR and  $\leq 7.5$  for 10-g extremity SAR,<sup>24</sup> where

- $f(\text{GHz})$  is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation<sup>25</sup>
- The result is rounded to one decimal place for comparison
- 3.0 and 7.5 are referred to as the numeric thresholds in the step 2 below
- If the test separation distance (antenna-user) is  $< 5$  mm, 5 mm is used for excluded SAR calculation

	Wireless Interface	Bluetooth
	Tune-up Maximum power (dBm)	7
	Tune-up Maximum rated power (mW)	5.012
Body	Antenna to user (mm)	5
	Frequency (GHz)	2.480
	SAR exclusion threshold	1.579
Head	Antenna to user (mm)	10
	Frequency (GHz)	2.480
	SAR exclusion threshold	0.789

Per KDB 447498 D01v06 exclusion thresholds is  $[(\text{max. power of channel, including tune-up tolerance: } 5.012 \text{ mW}) / (\text{min. test separation distance: } 5 \text{ mm})] \cdot [\sqrt{2.480}] = 1.579 < 3$ , Bluetooth RF exposure evaluation is not required.

According to RSS102-2015 :

SAR evaluation for this device was performed with a separation distance of 5 mm. Observing the SAR evaluation exemption limit table (Table 1, see below) found in § 2.5.1 of RSS102:2015 , it was determined that the SAR exemption limit for this device is 4 mW for 2.4GHz transmission. No Wi-Fi mode qualified for test exemption as all power levels were above the stated thresholds. On the contrary, Bluetooth, with a frequency of 2440 MHz and a maximum output power of 3.98 mW (6 dBm, tune-up tolerance accounted for), is lower than the exemption threshold and therefore exempt from SAR evaluation for either the intended user or bystanders. So Bluetooth RF exposure evaluation is not required

**Table 1: SAR evaluation – Exemption limits for routine evaluation based on frequency and separation distance**

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of ≤5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤300	71 mW	101 mW	132 mW	162 mW	193 mW
450	52 mW	70 mW	88 mW	106 mW	123 mW
835	17 mW	30 mW	42 mW	55 mW	67 mW
1900	7 mW	10 mW	18 mW	34 mW	60 mW
2450	4 mW	7 mW	15 mW	30 mW	52 mW
3500	2 mW	6 mW	16 mW	32 mW	55 mW
5800	1 mW	6 mW	15 mW	27 mW	41 mW

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of 30 mm	At separation distance of 35 mm	At separation distance of 40 mm	At separation distance of 45 mm	At separation distance of ≥50 mm
≤300	223 mW	254 mW	284 mW	315 mW	345 mW
450	141 mW	159 mW	177 mW	195 mW	213 mW
835	80 mW	92 mW	105 mW	117 mW	130 mW
1900	99 mW	153 mW	225 mW	316 mW	431 mW
2450	83 mW	123 mW	173 mW	235 mW	309 mW
3500	86 mW	124 mW	170 mW	225 mW	290 mW
5800	56 mW	71 mW	85 mW	97 mW	106 mW

Band / Mode	Maximum Tune-up Power(dBm)		
	V2.1 + EDR, GFSK	V2.1+ EDR, $\pi/4$ -DQPSK	V2.1 + EDR, 8-DPSK
Bluetooth	7	4	4

Band / Mode	Maximum Tune-up Power(dBm)
	BLE4.2, GFSK
Bluetooth	7

Band / Mode	Channel	SISO Maximum Tune up Power (dBm)
802.11b	1-11	16.5
802.11g	1-11	16.5
802.11n 20MHz	1-11	15.5

## 11.5 SAR TEST CONFIGURATIONS

### Wrist-worn device Exposure Conditions

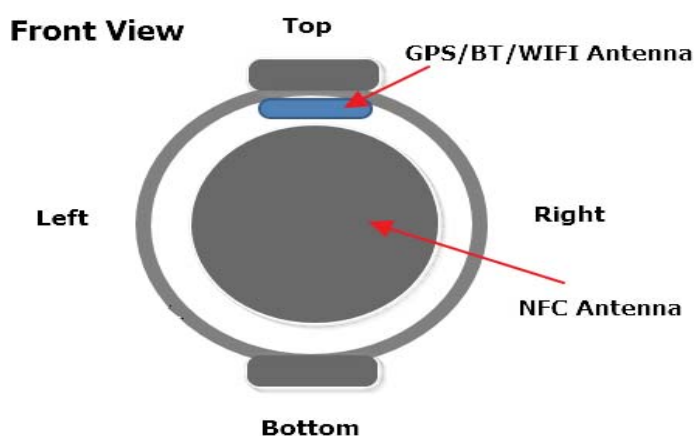
(a) Transmitters that are built-in within a wrist watch or similar wrist-worn devices typically operate in speaker mode for voice communication, with the device worn on the wrist and positioned next to the mouth. Next to the mouth exposure requires 1-g SAR, and the wrist-worn condition requires 10-g extremity SAR.

(b) The 10-g extremity and 1-g SAR test exclusions may be applied to the wrist and face exposure conditions. When SAR evaluation is required, next to the mouth use is evaluated with the front of the device positioned at 10 mm from a flat phantom filled with head tissue-equivalent medium.

(c) For wrist-worn condition, 10g SAR value should be measured for the inner wrist band at a separation of 0mm. The design of the hard wrist band prevents opening it to a flat shape to be placed under the flat phantom.

(d) Next to the mouth use is evaluated with the front of the device positioned at 10 mm from a flat phantom filled with head tissue-equivalent medium. SAR for wrist exposure is evaluated with the back of the devices positioned in direct contact against a flat phantom fill with body tissue-equivalent medium. The wrist bands should be unstrapped and touching the phantom. The space introduced by the watch or wrist bands and the phantom must be representative of actual use conditions. The WIFI/BT antenna is in the watch strap, strap is fixed angle 70 angle with the plane of the Watch, removal of the plastic banding so that the EUT will fit flush against the phantom is acceptable.

### Antenna Position



Antenna Location

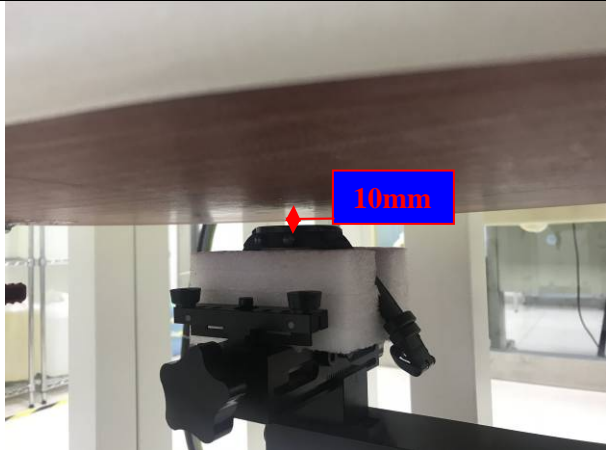
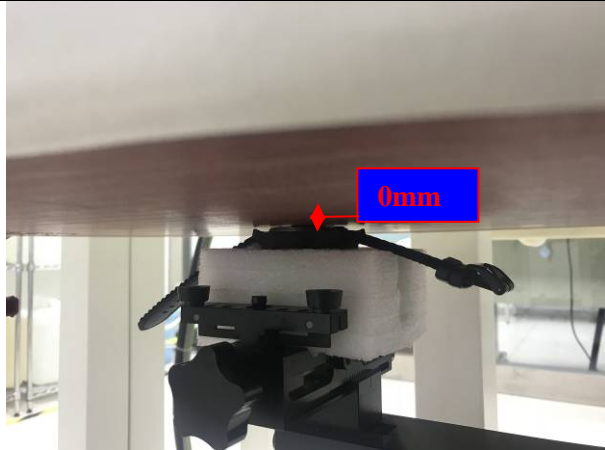
Antenna	Wireless Interface
WLAN Antenna	WLAN 2.4G Bluetooth

### Test Mode

IEEE 802.11g	Data transmission mode(802.11g)
--------------	---------------------------------

## 11.6 EUT SETUP PHOTOS

### Test position

Next-to-mouth condition position	wrist-worn condition position
	
<u>EUT Setup Configuration 1</u>	<u>EUT Setup Configuration 2</u>

## 11.7 SAR MEASUREMENT RESULTS

Band	Mode	Test Position	Dist. (mm)	Ch.	Freq. (MHZ)	max Power (dBm)	Tune- Up Limit (dBm)	Scaling Factor	Duty cycle scaling factor	Power Drift (dB)	SAR1g (mW/g)	Scaled SAR1g (mW/g)
WLAN 2.4G	802.11 g	Next-to-Mouth	10	1	2412	15.17	16.5	1.358	1	0.07	0.236	0.321
WLAN 2.4G	802.11 g	Next-to-Mouth	10	6	2437	15.76	16.5	1.186	1	-0.08	0.281	0.333
WLAN 2.4G	802.11 g	Next-to-Mouth	10	11	2462	16.02	16.5	1.117	1	-0.08	0.363	0.405

Band	Mode	Test Position	Dist. (mm)	Ch.	Freq. (MHZ)	max Power (dBm)	Tune- Up Limit (dBm)	Scaling Factor	Duty cycle scaling factor	Power Drift (dB)	SAR10g (mW/g)	Scaled SAR10g (mW/g)
WLAN 2.4G	802.11 g	Extremity (Wrist)	0	1	2412	15.17	16.5	1.358	1	-0.10	0.093	0.126
WLAN 2.4G	802.11 g	Extremity (Wrist)	0	6	2437	15.76	16.5	1.186	1	-0.16	0.084	0.100
WLAN 2.4G	802.11 g	Extremity (Wrist)	0	11	2462	16.02	16.5	1.117	1	-0.01	0.114	0.127



**11.8 REPEATED SAR MEASUREMENT**

Band	Mode	Test Position	Dist. (mm)	Ch.	Original Measured SAR1g (mW/g)	1st Repeated SAR1g (mW/g)	Ratio	Original Measured SAR1g (mW/g)	2nd Repeated SAR1g (mW/g)	Ratio
-	-	-	-	-	-	-	-	--	--	--

**Note:**

1. Per KDB 865664 D01, for each Frequency band, repeated SAR measurement is required only when the measured SAR is  $\geq 0.8 \text{ W/Kg}$
2. Per KDB 865664 D01, if the ratio of largest to smallest SAR for the original and first repeated measurement is  $\leq 1.2$  and the measured SAR  $< 1.45 \text{ W/Kg}$ , only one repeated measurement is required.
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  $\geq 1.45 \text{ W/kg}$
4. The ratio is the difference in percentage between original and repeated measured SAR.
5. The same procedures should be adapted for measurements according to extremity and occupational exposure limits by applying a factor of 2.5 for extremity exposure and a factor of 5 for occupational exposure to the corresponding SAR thresholds

## 12. SAR MULTI XMITER ASSESSMENT

No.	Applicable Simultaneous Transmission Combination
1	WLAN2.4GHz+BT

**Note:**

- 2.4GHz WLAN and BT share the same antenna, and can transmit simultaneously.
- The reported SAR summation is calculated based on the same configuration and test position.
- For simultaneous transmission analysis, Bluetooth SAR is estimated per KDB 447498 D01v05 based on the formula below.  

$$(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm}) \cdot [\sqrt{f(\text{GHz})/x}] \text{ W/kg}$$
for test separation distances  $\leq 50 \text{ mm}$ ; where  $x = 7.5$  for 1-g SAR, and  $x = 18.75$  for 10-g SAR.  
0.4 W/kg for 1-g SAR and 1.0 W/kg for 10-g SAR, when the test separation distances is  $> 50 \text{ mm}$ .

**Bluetooth:**

	Max power	Head (10mm distance)	Body (0mm distance)
Estimated SAR (W/kg)	7 dBm	0.105 W/kg	0.084 W/kg

- Per KDB 447498 D01v05, simultaneous transmission SAR is compliant if,
  - Scalar SAR summation  $< 1.6 \text{ W/kg}$ .
  - $\text{SPLSR} = (\text{SAR1} + \text{SAR2})1.5 / (\text{min. separation distance, mm})$ , and the peak separation distance is determined from the square root of  $[(x1-x2)^2 + (y1-y2)^2 + (z1-z2)^2]$ , where  $(x1, y1, z1)$  and  $(x2, y2, z2)$  are the coordinates of the extrapolated peak SAR locations in the zoom scan  
If  $\text{SPLSR} \leq 0.04$ , simultaneously transmission SAR is compliant
  - Simultaneously transmission SAR measurement, and the reported multi-band SAR  $< 1.6 \text{ W/kg}$

SUM $\Sigma$ SAR1g (WLAN(2.4G + Bluetooth)				
Position	Distance	Stand alone SAR(1g) [W/kg]		SUM SAR(1g)[W/kg]
	[mm]	WLAN 2.4G	Bluetooth	WLAN(2.4G)+ Bluetooth
Next-to-Mouth	10	0.405	0.105	0.510

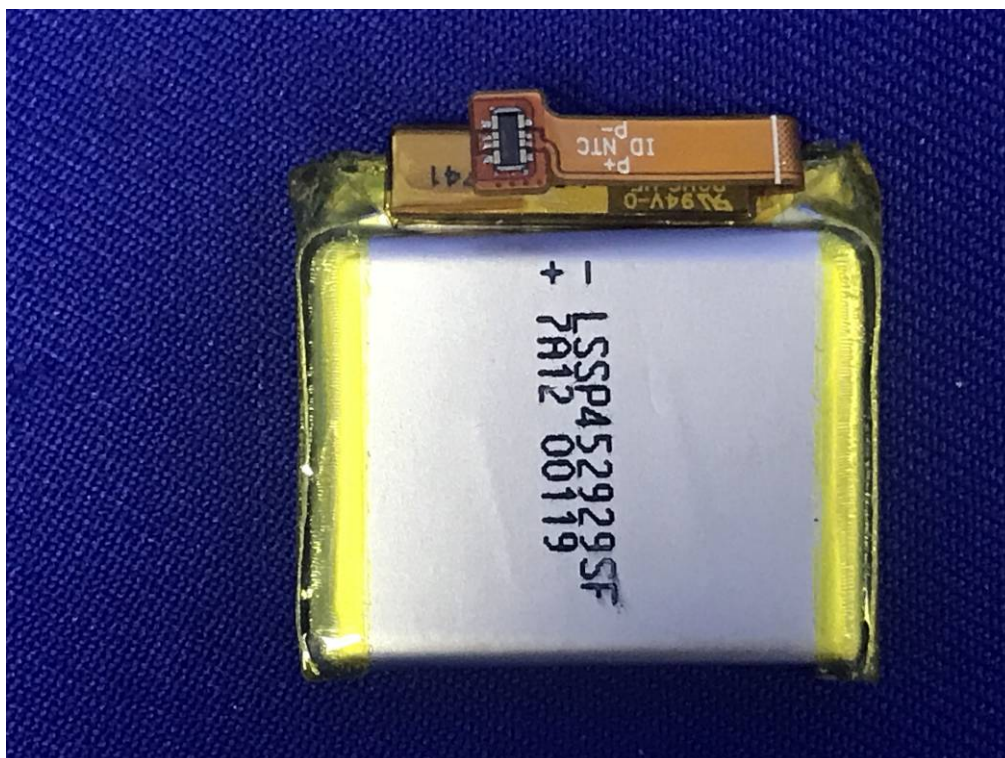
SUM $\Sigma$ SAR10g (WLAN(2.4G + Bluetooth)				
Position	Distance	Stand alone SAR(1g) [W/kg]		SUM SAR(10g)[W/kg]
	[mm]	WLAN 2.4G	Bluetooth	WLAN(2.4G)+ Bluetooth
Extremity (Wrist)	0	0.127	0.084	0.211

### 13. EUT PHOTO











**14. EQUIPMENT LIST & CALIBRATION STATUS**

Name of Equipment	Manufacturer	Type/Model	Serial Number	Last Calibration	Calibration Due
P C	HP	Core(rm)3.16G	CZCO48171H	N/A	N/A
Signal Generator	Agilent	E8257C	US37101915	02/26/2018	02/25/2019
S-Parameter Network Analyzer	Agilent	E5071B	MY42301382	02/26/2018	02/25/2019
Power meter	Anritus	ML2495A	1445010	04/26/2018	04/25/2019
Power sensor	Anritus	MA2411B	1339220	04/26/2018	04/25/2019
E-field PROBE	SPEAG	EX3DV4	3798	07/26/2017	07/25/2018
DAE	SPEAG	DEA4	1245	07/20/2017	07/19/2018
DIPOLE 2450MHZ ANTENNA	SPEAG	D2450V2	817	05/29/2018	05/28/2019
Electro Thermometer	DTM	DTM3000	3030	12/26/2017	12/25/2018
3db ATTENUATOR	MINI	MCL BW-S3W5	0533	N/A	N/A
DUMMY PROBE	SPEAG	DP_2	SPDP2001AA	N/A	N/A
Dual Directional Coupler	Woken	20W couple	DOM2BHW1A1	N/A	N/A
SAM PHANTOM (ELI4 v4.0)	SPEAG	QDOVA001BB	1102	N/A	N/A
Twin SAM Phantom	SPEAG	QD000P40CD	1609	N/A	N/A
ROBOT	SPEAG	TX60	F10/5E6AA1/A101	N/A	N/A
ROBOT KRC	SPEAG	CS8C	F10/5E6AA1/C101	N/A	N/A
LIQUID CALIBRATION KIT	ANTENNESSA	41/05 OCP9	00425167	N/A	N/A

## 15. FACILITIES

All measurement facilities used to collect the measurement data are located at

☒ No.10, Weiye Rd., Innovation Park, Eco & Tec. Development Part, Kunshan City, Jiangsu Province, China.

## 16. REFERENCES

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## APPENDIX A: PLOTS OF PERFORMANCE CHECK

The plots are showing as followings.



Test Laboratory: Compliance Certification Services Inc.

Date: 5/9/2018

**SystemPerformanceCheck-Body D2450****DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 817**

Communication System: UID 0, CW; Communication System Band: D2450 (2450.0 MHz); Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.956$  S/m;  $\epsilon_r = 51.83$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Room Ambient Temperature: 22°C; Liquid Temperature: 21.5°C

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration:

- Probe: EX3DV4 - SN3798; ConvF(7.32, 7.32, 7.32); Calibrated: 7/26/2017;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1245; Calibrated: 7/20/2017
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:xxxx
- DASY52 52.8.8(1222);
- SEMCAD X Version 14.6.10 (7331)

**System Performance Check at Frequencies above 1 GHz/Pin=250 mW, dist=10mm (EX-Probe)/Area Scan (9x10x1):** Measurement grid: dx=12mm, dy=12mm

Maximum value of SAR (measured) = 17.0 W/kg

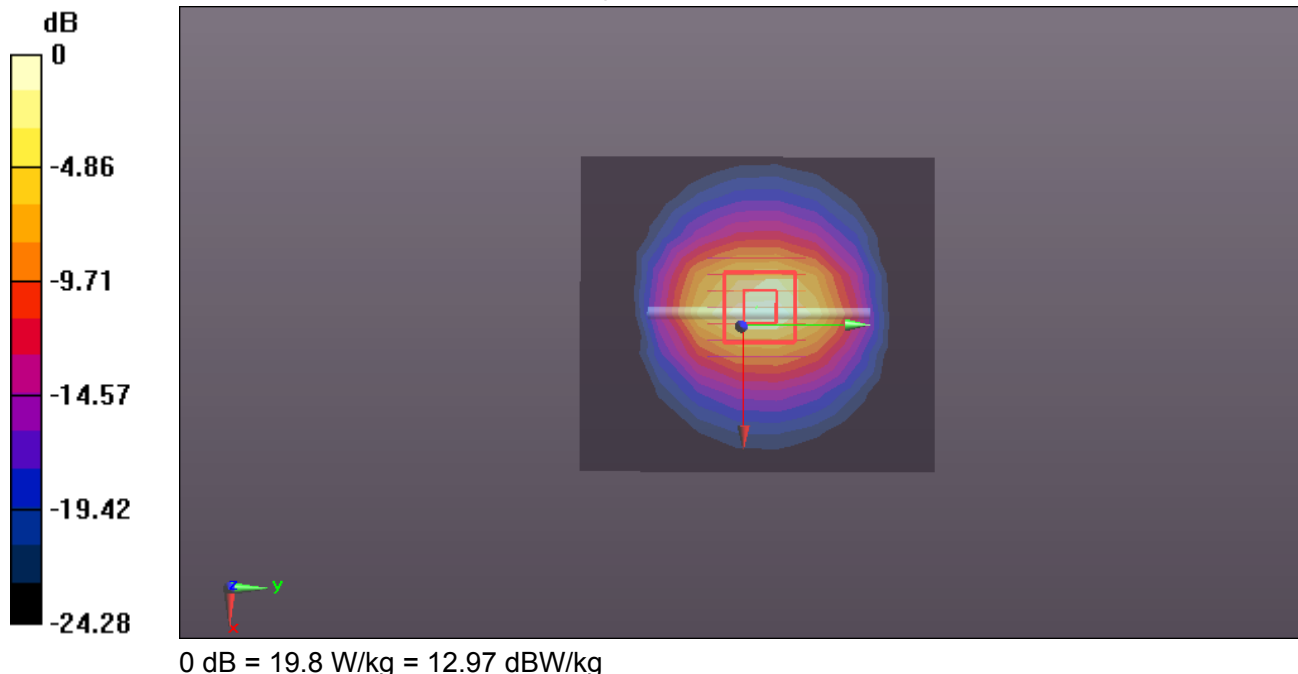
**System Performance Check at Frequencies above 1 GHz/Pin=250 mW, dist=10mm (EX-Probe)/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 99.65 V/m; Power Drift = -0.15 dB

Peak SAR (extrapolated) = 25.5 W/kg

**SAR(1 g) = 12.6 W/kg; SAR(10 g) = 6.17 W/kg**

Maximum value of SAR (measured) = 19.8 W/kg



Test Laboratory: Compliance Certification Services Inc.

Date: 5/8/2018

**System Performance Check-Head D2450****DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 817**

Communication System: UID 0, CW; Communication System Band: D2450 (2450.0 MHz); Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.764$  S/m;  $\epsilon_r = 40.539$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Room Ambient Temperature: 22°C; Liquid Temperature: 21.5°C

Phantom section: Flat Section

Measurement Standard: DASYS (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration:

- Probe: EX3DV4 - SN3798; ConvF(7.4, 7.4, 7.4); Calibrated: 7/26/2017;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1245; Calibrated: 7/20/2017
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:xxxx
- DASY52 52.8.8(1222);
- SEMCAD X Version 14.6.10 (7331)

**System Performance Check at Frequencies above 1 GHz/Pin=250 mW, dist=10mm (EX-Probe)/Area Scan (9x10x1):** Measurement grid: dx=12mm, dy=12mm

Maximum value of SAR (measured) = 16.9 W/kg

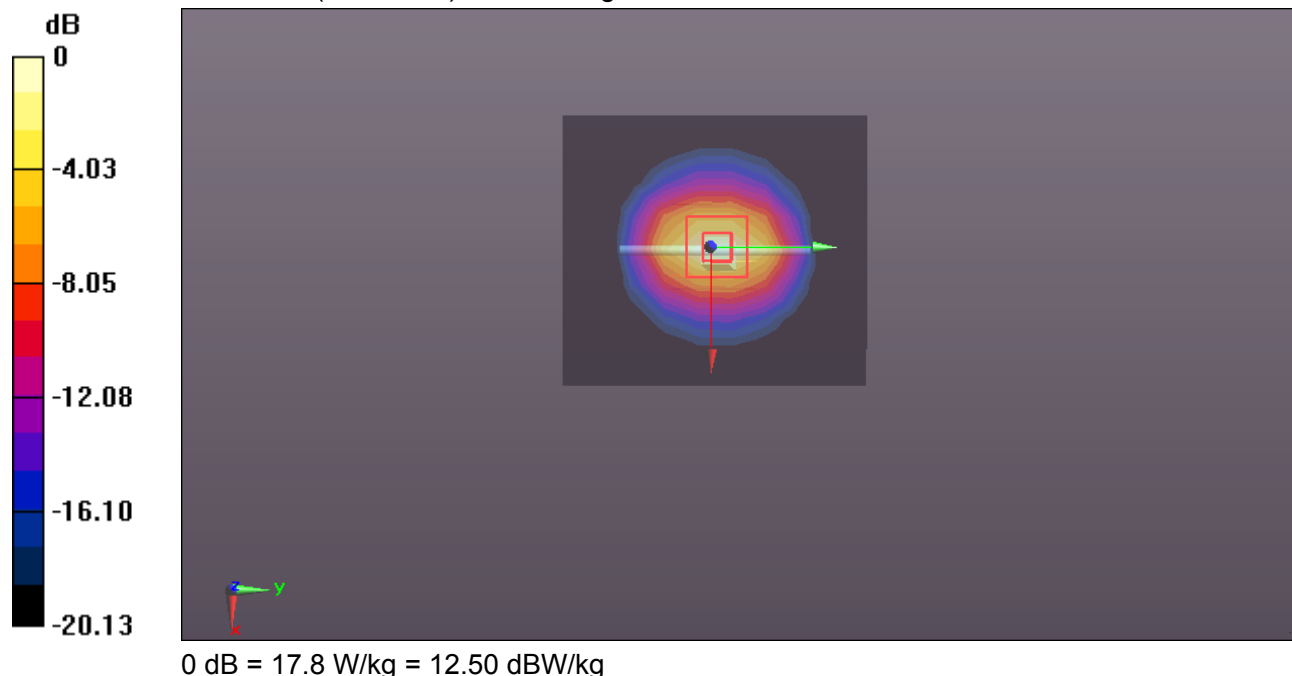
**System Performance Check at Frequencies above 1 GHz/Pin=250 mW, dist=10mm (EX-Probe)/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 103.1 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 27.8 W/kg

**SAR(1 g) = 13.0 W/kg; SAR(10 g) = 6.09 W/kg**

Maximum value of SAR (measured) = 17.8 W/kg



Test Laboratory: Compliance Certification Services Inc.

Date: 6/4/2018

**SystemPerformanceCheck-Head D2450****DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 817**

Communication System: UID 0, CW; Communication System Band: D2450 (2450.0 MHz); Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.777$  S/m;  $\epsilon_r = 37.756$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Room Ambient Temperature: 22°C; Liquid Temperature: 21.5°C

Phantom section: Flat Section

Measurement Standard: DASYS (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration:

- Probe: EX3DV4 - SN3798; ConvF(7.4, 7.4, 7.4); Calibrated: 7/26/2017;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1245; Calibrated: 7/20/2017
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:xxxx
- DASY52 52.8.8(1222);
- SEMCAD X Version 14.6.10 (7331)

**System Performance Check at Frequencies above 1 GHz/Pin=250 mW, dist=10mm (EX-Probe)/Area Scan (9x10x1):** Measurement grid: dx=12mm, dy=12mm

Maximum value of SAR (measured) = 16.4 W/kg

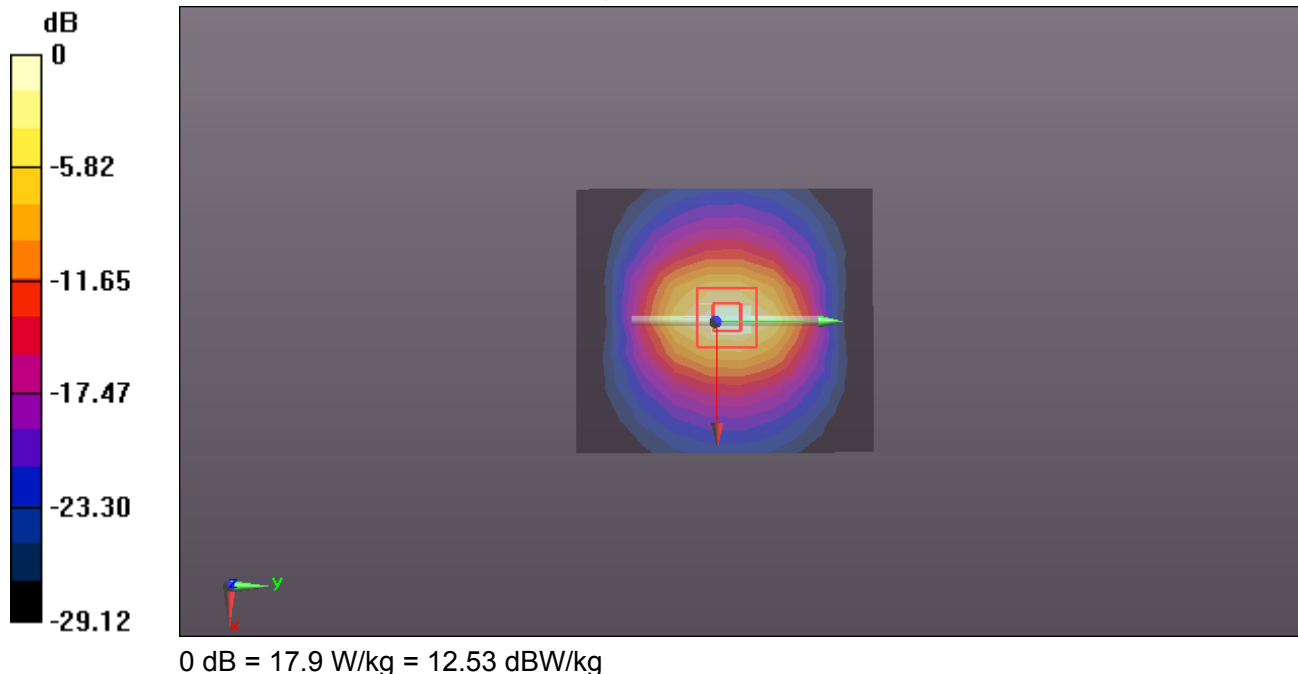
**System Performance Check at Frequencies above 1 GHz/Pin=250 mW, dist=10mm (EX-Probe)/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 100.8 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 27.2 W/kg

**SAR(1 g) = 12.7 W/kg; SAR(10 g) = 6.03 W/kg**

Maximum value of SAR (measured) = 17.9 W/kg



Test Laboratory: Compliance Certification Services Inc.

Date: 6/4/2018

**SystemPerformanceCheck-Body D2450****DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 817**

Communication System: UID 0, CW; Communication System Band: D2450 (2450.0 MHz); Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.965$  S/m;  $\epsilon_r = 52.159$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Room Ambient Temperature: 22°C; Liquid Temperature: 21.5°C

Phantom section: Flat Section

Measurement Standard: DASYS (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration:

- Probe: EX3DV4 - SN3798; ConvF(7.32, 7.32, 7.32); Calibrated: 7/26/2017;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1245; Calibrated: 7/20/2017
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:xxxx
- DASYS 52.8.8(1222);
- SEMCAD X Version 14.6.10 (7331)

**System Performance Check at Frequencies above 1 GHz/Pin=250 mW, dist=10mm (EX-Probe)/Area Scan (9x10x1):** Measurement grid: dx=12mm, dy=12mm

Maximum value of SAR (measured) = 16.8 W/kg

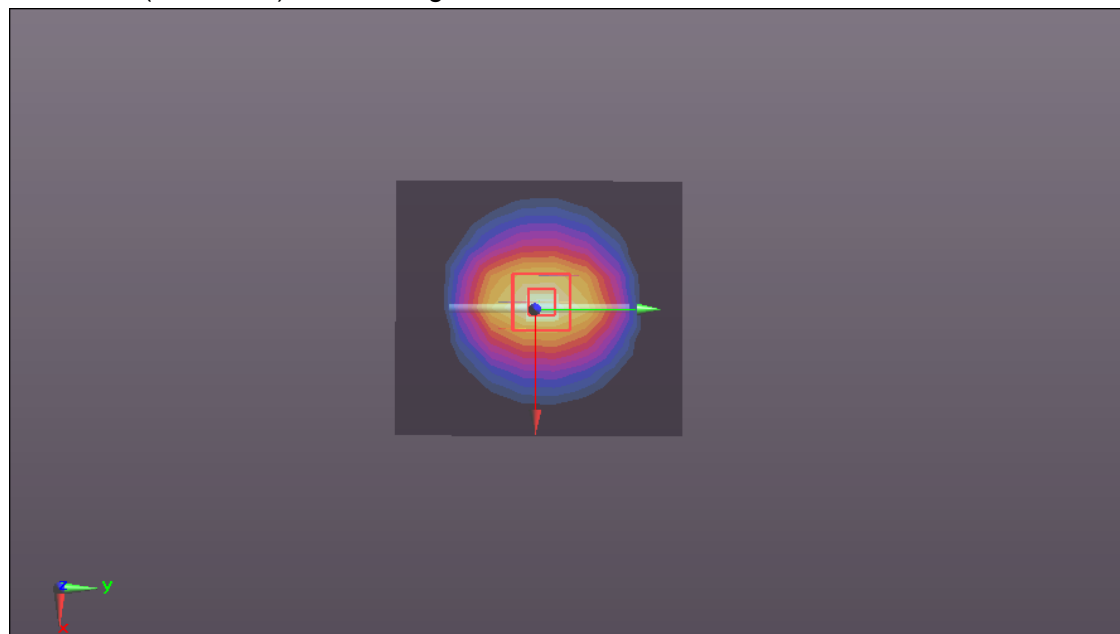
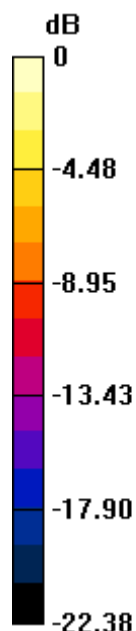
**System Performance Check at Frequencies above 1 GHz/Pin=250 mW, dist=10mm (EX-Probe)/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 98.41 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 25.6 W/kg

**SAR(1 g) = 12.9 W/kg; SAR(10 g) = 5.98 W/kg**

Maximum value of SAR (measured) = 19.2 W/kg



0 dB = 19.2 W/kg = 12.83 dBW/kg

**APPENDIX B: DASY CALIBRATION CERTIFICATE**

The DASY Calibration Certificates are showing in the file named Appendix B: DASY Calibration Certificate.

**APPENDIX C: PLOTS OF SAR TEST RESULT**

The plots are showing in the file named Appendix C Plots of SAR Test Result

**END REPORT**