


FCC SAR Test Report

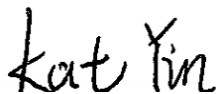
APPLICANT : Elo Touch Solutions, Inc.
EQUIPMENT : Mobile POS
BRAND NAME : ELO or 
MODEL NAME : EMC0600
FCC ID : RBWEMC0600
STANDARD : FCC 47 CFR Part 2 (2.1093)

We, Sporton International (Kunshan) Inc., would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this variant 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.



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Approved by: Kat Yin / Manager



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1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for **Elo Touch Solutions, Inc., Mobile POS, EMC0600**, are as follows.

Highest 1g SAR Summary				
Equipment Class	Frequency Band		Body-worn (Separation 10mm)	Highest Simultaneous Transmission 1g SAR (W/kg)
DTS	WLAN	2.4GHz WLAN	0.12	0.48
NII		5GHz WLAN	0.76	1.23
DSS	Bluetooth	2.4GHz Bluetooth	0.27	0.19
Date of Testing:			2021/7/31 ~ 2021/9/14	

Highest 10g SAR Summary				
Equipment Class	Frequency Band		Limbs (Separation 0mm)	Highest Simultaneous Transmission 10g SAR (W/kg)
DTS	WLAN	2.4GHz WLAN	0.52	0.87
NII		5GHz WLAN	0.36	0.60
DSS	Bluetooth	2.4GHz Bluetooth	0.13	0.49
Date of Testing:			2021/7/31 ~ 2021/9/14	

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 exposure limits (1.6 W/kg for Partial-Body 1g SAR, 4.0 W/kg for Limbs 10g SAR) 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		
Test Site No.	Sporton Site No.	FCC Designation No.	FCC Test Firm Registration No.
	SAR01-KS	CN1257	314309

Applicant	
Company Name	Elo Touch Solutions, Inc.
Address	670 N. McCarthy Blvd. Suite 100, Milpitas, CA 95035, United States

Manufacturer	
Company Name	Elo Touch Solutions, Inc.
Address	670 N. McCarthy Blvd. Suite 100, Milpitas, CA 95035, United States

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	Mobile POS
Brand Name	ELO or 
Model Name	EMC0600
FCC ID	RBWEMC0600
S/N	B213A20068
Wireless Technology and Frequency Range	WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz WLAN 5.2GHz Band: 5180 MHz ~ 5240 MHz WLAN 5.3GHz Band: 5260 MHz ~ 5320 MHz WLAN 5.5GHz Band: 5500 MHz ~ 5700 MHz WLAN 5.8GHz Band: 5745 MHz ~ 5825 MHz Bluetooth: 2402 MHz ~ 2480 MHz NFC : 13.56 MHz
Mode	WLAN 2.4GHz : 802.11b/g/n HT20/HT40 WLAN 5GHz 802.11a/n HT20/HT40 WLAN 5GHz 802.11ac VHT20/VHT40/VHT80//VHT80+ VHT80 Bluetooth BR/EDR/LE NFC:ASK
HW Version	A01
SW Version	5.07.100
EUT Stage	Production Unit
Remark:	
1. This device does not support voice function.	

5. RF Exposure Limits

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

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.

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:

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

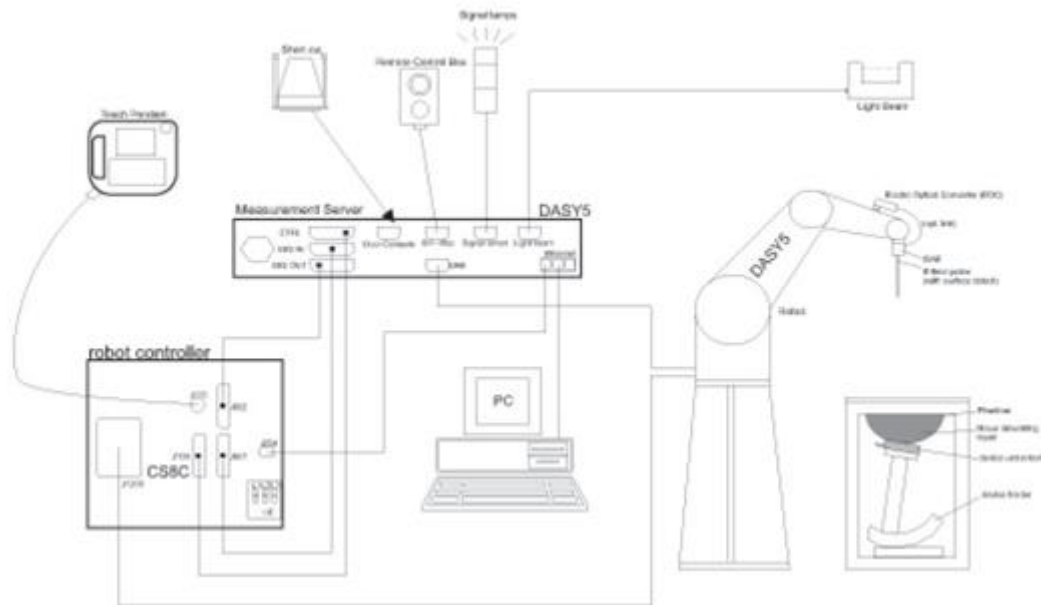
SAR is expressed in units of Watts per kilogram (W/kg)

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

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 E-Field Probe

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) ±0.5 dB in TSL (rotation normal to probe axis)	
Dynamic Range	10 µW/g – >100 mW/g Linearity: ±0.2 dB (noise: typically <1 µW/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.



Photo of DAE

7.3 Phantom

<SAM Twin Phantom>

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
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: 600 mm Minor axis: 400 mm



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 Device Holder

<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. Measurement Procedures

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 from 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.

	≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	5 ± 1 mm	$\frac{1}{2} \cdot \delta \cdot \ln(2) \pm 0.5$ mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: Δx_{Area} , Δy_{Area}	≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
	When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	

8.4 Zoom Scan

Zoom scans are used to 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 whose 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.

		≤ 3 GHz	> 3 GHz	
Maximum zoom scan spatial resolution: $\Delta x_{Zoom}, \Delta y_{Zoom}$		≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*	
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$	≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm	
	graded grid	$\Delta z_{Zoom}(1)$: between 1 st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$	
Minimum zoom scan volume	x, y, z	≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 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 <i>reported</i> SAR from the <i>area scan based 1-g SAR estimation</i> procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.				

8.5 Volume Scan Procedures

The volume scan is used to 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

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	2450MHz System Validation Kit	D2450V2	908	2019/3/25	2022/3/23
SPEAG	5000MHz System Validation Kit	D5GHzV2	1113	2019/9/24	2022/9/23
SPEAG	Data Acquisition Electronics	DAE4	799	2021/3/26	2022/3/25
SPEAG	Data Acquisition Electronics	DAE4	1303	2021/6/18	2022/6/17
SPEAG	Dosimetric E-Field Probe	EX3DV4	3843	2020/9/23	2021/9/22
SPEAG	Dosimetric E-Field Probe	EX3DV4	7592	2021/6/24	2022/6/23
SPEAG	SAM Twin Phantom	SAM Twin	TP-1754	NCR	NCR
SPEAG	Phone Positioner	N/A	N/A	NCR	NCR
Anritsu	Radio Communication Analyzer	MT8821C	6201432831	2021/4/13	2022/4/12
Agilent	ENA Series Network Analyzer	E5071C	MY46112129	2020/10/17	2021/10/16
SPEAG	Dielectric Probe Kit	DAK-3.5	1144	2020/12/2	2021/12/1
Anritsu	Vector Signal Generator	MG3710A	6201682672	2021/1/7	2022/1/6
Rohde & Schwarz	Power Meter	NRVD	102081	2020/8/13	2021/8/12
Rohde & Schwarz	Power Meter	NRVD	102081	2021/8/12	2022/8/11
Rohde & Schwarz	Power Sensor	NRV-Z5	100538	2020/8/13	2021/8/12
Rohde & Schwarz	Power Sensor	NRV-Z5	100538	2021/8/12	2022/8/11
Rohde & Schwarz	Power Sensor	NRV-Z5	100539	2020/8/13	2021/8/12
Rohde & Schwarz	Power Sensor	NRV-Z5	100539	2021/8/12	2022/8/11
R&S	CBT BLUETOOTH TESTER	CBT	101246	2021/4/12	2022/4/11
EXA	Spectrum Analyzer	FSV7	101632	2021/1/7	2022/1/6
FLUKE	DIGITAC THERMOMETER	51II	97240029	2020/8/14	2021/8/13
FLUKE	DIGITAC THERMOMETER	51II	97240029	2021/8/13	2022/8/12
Testo	Hygrometer	608-H1	1241332126	2021/1/7	2022/1/6
ARRA	Power Divider	A3200-2	N/A	Note 1	
MCL	Attenuation1	BW-S10W5+	N/A	Note 1	
MCL	Attenuation2	BW-S10W5+	N/A	Note 1	
MCL	Attenuation3	BW-S10W5+	N/A	Note 1	
BONN	POWER AMPLIFIER	BLMA 0830-3	087193A	Note 1	
BONN	POWER AMPLIFIER	BLMA 2060-2	087193B	Note 1	
Agilent	Dual Directional Coupler	778D	20500	Note 1	
Agilent	Dual Directional Coupler	11691D	MY48151020	Note 1	

Note:

1. 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.
2. Referring to KDB 865664 D01v01r04, the dipole calibration interval can be extended to 3 years with justification. The dipoles are also not physically damaged, or repaired during the interval.
3. The justification data of dipole can be found in appendix C. The return loss is < -20dB, within 20% of prior calibration, the impedance is within 5 ohm of prior calibration.

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.

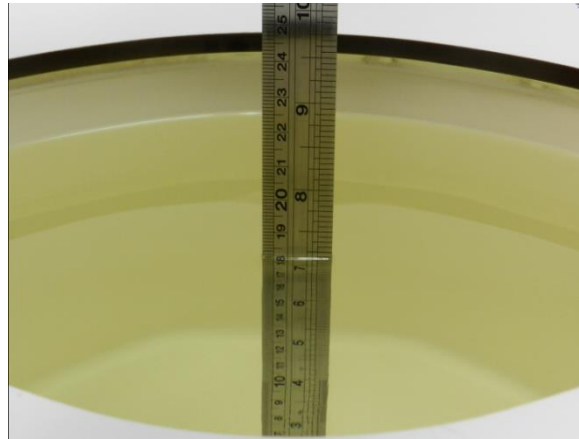


Fig 10.1 Photo of Liquid Height for Body SAR



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								
750	41.1	57.0	0.2	1.4	0.2	0	0.89	41.9
835	40.3	57.9	0.2	1.4	0.2	0	0.90	41.5
1800, 1900, 2000	55.2	0	0	0.3	0	44.5	1.40	40.0
2450	55.0	0	0	0	0	45.0	1.80	39.2

Simulating Liquid for 5GHz, Manufactured by SPEAG

Ingredients	(% by weight)
Water	64~78%
Mineral oil	11~18%
Emulsifiers	9~15%
Additives and Salt	2~3%

<Tissue Dielectric Parameter Check Results>

Frequency (MHz)	Tissue Type	Liquid Temp. (°C)	Conductivity (σ)	Permittivity (εr)	Conductivity Target (σ)	Permittivity Target (εr)	Delta (σ) (%)	Delta (εr) (%)	Limit (%)	Date
2450	Head	22.8	1.774	39.476	1.80	39.20	-1.44	0.70	±5	2021/7/31
5250	Head	22.6	4.690	36.422	4.71	35.90	-0.42	1.45	±5	2021/8/2
5600	Head	22.6	5.034	35.819	5.07	35.50	-0.71	0.90	±5	2021/8/4
5750	Head	22.7	5.281	35.507	5.22	35.40	1.17	0.30	±5	2021/8/6
2450	Head	22.6	1.810	38.622	1.80	39.20	0.56	-1.47	±5	2021/9/14
5250	Head	22.6	4.594	36.251	4.71	35.90	-2.46	0.98	±5	2021/9/13
5600	Head	22.7	4.973	35.717	5.07	35.50	-1.91	0.61	±5	2021/9/13
5750	Head	22.6	5.148	35.533	5.22	35.40	-1.38	0.38	±5	2021/9/14

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.

<1g SAR>

Date	Frequency (MHz)	Tissue Type	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Measured 1g SAR (W/kg)	Targeted 1g SAR (W/kg)	Normalized 1g SAR (W/kg)	Deviation (%)
2021/7/31	2450	Head	50	908	3843	799	2.74	52.80	54.8	3.79
2021/8/2	5250	Head	50	1113	3843	799	4.25	80.50	85	5.59
2021/8/4	5600	Head	50	1113	3843	799	4.36	83.40	87.2	4.56
2021/8/6	5750	Head	50	1113	3843	799	4.31	80.00	86.2	7.75
2021/9/14	2450	Head	50	908	7592	1303	2.68	52.80	53.6	1.52
2021/9/13	5250	Head	50	1113	7592	1303	3.84	80.50	76.8	-4.60
2021/9/13	5600	Head	50	1113	7592	1303	4.28	83.40	85.6	2.64
2021/9/14	5750	Head	50	1113	7592	1303	4.06	80.00	81.2	1.50

<10g SAR>

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 (%)
2021/7/31	2450	Head	50	908	3843	799	1.25	24.20	25	3.31
2021/8/2	5250	Head	50	1113	3843	799	1.23	23.10	24.6	6.49
2021/8/4	5600	Head	50	1113	3843	799	1.26	23.80	25.2	5.88
2021/8/6	5750	Head	50	1113	3843	799	1.21	22.80	24.2	6.14
2021/9/14	2450	Head	50	908	7592	1303	1.25	24.20	25	3.31
2021/9/13	5250	Head	50	1113	7592	1303	1.10	23.10	22	-4.76
2021/9/13	5600	Head	50	1113	7592	1303	1.22	23.80	24.4	2.52
2021/9/14	5750	Head	50	1113	7592	1303	1.11	22.80	22.2	-2.63

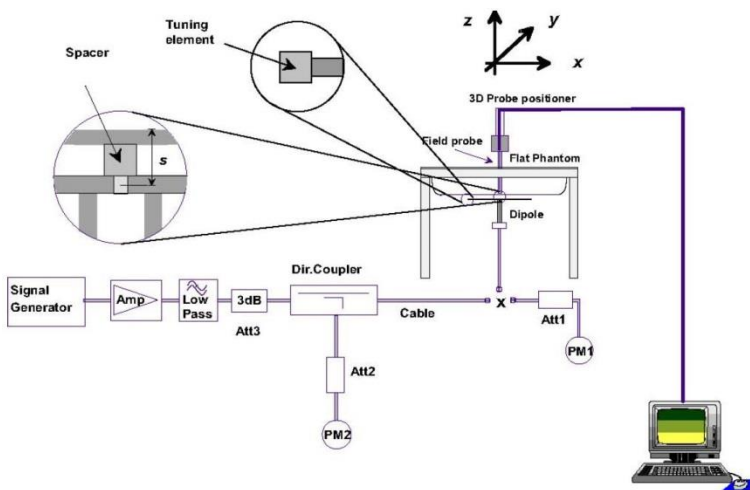


Fig 10.3.1 System Performance Check Setup



Fig 10.3.2 Setup Photo



11. RF Exposure Positions

11.1 Body-worn SAR Testing for Device

- (a) To position the device parallel to the phantom surface with Front and Back surfaces of the device.
- (b) To adjust the device parallel to the flat phantom.
- (c) To adjust the distance between the device surface and the flat phantom to 10 mm.

11.2 Handheld SAR Testing for Device

- (b) To position the device parallel to the phantom surface with all surfaces of the device.
- (b) To adjust the device parallel to the flat phantom.
- (c) To adjust the distance between the device surface and the flat phantom to 0 mm.

Please refer to Appendix D for the test setup photos.

12. WiFi/Bluetooth Output Power (Unit: dBm)

The detailed conducted power table can refer to Appendix E.

<WLAN Conducted Power>

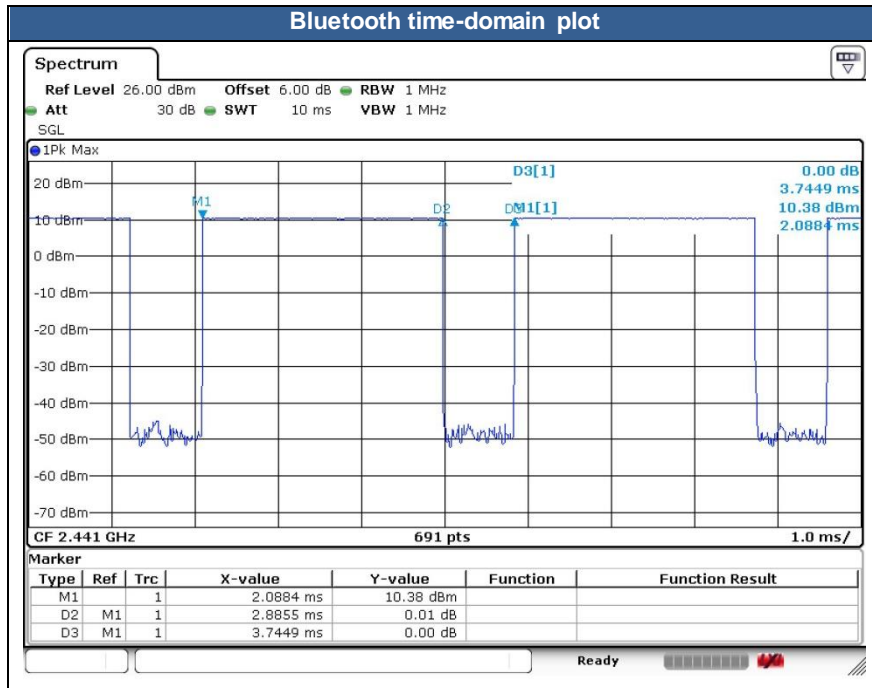
General Note:

1. The reported TX power in EMC report is per actual shipping power setting and measured in this unit, the power set for SAR test is included the tune-up tolerance which is considered as worst case.
2. For the conducted power measurement is MIMO chains transmitting simultaneously and measured the separately conducted power for both chains and then based on the conducted power of antenna 1 and antenna 2 respectively to calculate sum of the power for MIMO mode.
3. 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 and 5 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.
4. 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 and 5 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).
5. For OFDM transmission configurations in the 2.4 GHz and 5 GHz bands, 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/ac mode is used for SAR measurement, on the highest measured output power channel for each frequency band.
6. 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.

<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 77.05 % as following figure, according to 2016 Oct. TCB workshop for Bluetooth SAR scaling need further consideration and the duty cycle is 100%, therefore the actual duty cycle will be scaled up to the value of Bluetooth reported SAR calculation





13. Antenna Location

The detailed antenna location information can refer to SAR Test Setup Photos.



14. SAR Test Results

General Note:

- Per KDB 447498 D01v06, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
 - 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.
 - For SAR testing of WLAN/Bluetooth 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)"
 - For WLAN/Bluetooth: Reported SAR(W/kg)= Measured SAR(W/kg)* Duty Cycle scaling factor * Tune-up scaling factor
- 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:
 - ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 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
- Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required when the measured SAR is ≥ 0.8W/kg. Per KDB 865664 D01v01r04, if the extremity repeated SAR is necessary, 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.
- Based on WLAN2.4GHz and Bluetooth share the same antenna1, so Bluetooth RF exposure evaluation chose the worst position of WLAN2.4GHz Ant 1 to perform Bluetooth SAR test, and used this Bluetooth SAR value conservatively represent other position do co-located analysis with WLAN5GHz.
- For Limbs SAR testing, only performed within a transmitting antenna located within 25mm from that surface or edge.
- While 1-g SAR thresholds are specified in the procedures for SAR test reduction and exclusion, these thresholds should be multiplied by 2.5 when 10-g extremity SAR is considered.
- For WLAN5GHz/BT 0mm SAR can represent body-worn SAR data and can be used for simultaneous transmission analysis.

WLAN Note:

- 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.
- Per KDB 248227 D01v02r02, U-NII-1 SAR testing is not required when the U-NII-2A band highest reported SAR for a test configuration is ≤ 1.2 W/kg, SAR is not required for U-NII-1 band.
- 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.
- During SAR testing the WLAN transmission was verified using a spectrum analyzer.
- Bluetooth and WLAN share the same antenna, with similar work frequency, so for Bluetooth SAR testing, we chose the worst position of WLAN to perform.



14.1 Body-worn SAR

<WLAN 2.4GHz SAR>

Plo No.	Band	Mode	Test Position	Gap (mm)	Antenna	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	WLAN2.4GHz	802.11b 1Mbps	Front	10mm	Ant 1	1	2412	16.72	18.00	1.343	100	1.000	0.03	0.081	0.109
	WLAN2.4GHz	802.11b 1Mbps	Back	10mm	Ant 1	1	2412	16.72	18.00	1.343	100	1.000	-0.12	0.063	0.085
06	WLAN2.4GHz	802.11b 1Mbps	Front	10mm	Ant 1	6	2437	16.63	18.00	1.371	100	1.000	-0.06	0.087	0.119
	WLAN2.4GHz	802.11b 1Mbps	Front	10mm	Ant 1	11	2462	16.66	18.00	1.361	100	1.000	0.19	0.083	0.113
	WLAN2.4GHz	802.11b 1Mbps	Front	10mm	Ant 2	11	2462	16.87	18.00	1.297	100	1.000	-0.05	0.022	0.029
	WLAN2.4GHz	802.11b 1Mbps	Back	10mm	Ant 2	11	2462	16.87	18.00	1.297	100	1.000	0.12	0.068	0.088
	WLAN2.4GHz	802.11b 1Mbps	Back	10mm	Ant 2	1	2412	16.82	18.00	1.312	100	1.000	-0.03	0.078	0.102
	WLAN2.4GHz	802.11b 1Mbps	Back	10mm	Ant 2	6	2437	16.76	18.00	1.330	100	1.000	0.01	0.069	0.092

<Bluetooth SAR>

Plo No.	Band	Mode	Test Position	Gap (mm)	Antenna	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
07	Bluetooth	1Mbps	Front	0mm	Ant 1	39	2441	10.25	10.50	1.059	77.05	1.298	0.02	0.197	0.271
	Bluetooth	1Mbps	Front	0mm	Ant 1	0	2402	9.44	10.50	1.276	77.05	1.298	0.08	0.163	0.270
	Bluetooth	1Mbps	Front	0mm	Ant 1	78	2480	8.77	10.50	1.489	77.05	1.298	-0.16	0.086	0.166

<WLAN 5GHz SAR>

Plo No.	Band	Mode	Test Position	Gap (mm)	Antenna	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	WLAN5GHz	802.11a 6Mbps	Front	0mm	Ant 1	56	5280	12.13	13.00	1.223	98.27	1.018	-0.1	0.243	0.303
08	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 1	56	5280	12.13	13.00	1.223	98.27	1.018	0.03	0.279	0.347
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 1	52	5260	12.03	13.00	1.250	98.27	1.018	0.07	0.205	0.261
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 1	64	5320	12.06	13.00	1.242	98.27	1.018	0.03	0.240	0.303
	WLAN5GHz	802.11a 6Mbps	Front	0mm	Ant 2	56	5280	12.57	13.50	1.238	98.35	1.017	0.13	0.097	0.122
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 2	56	5280	12.57	13.50	1.238	98.35	1.017	-0.02	0.223	0.281
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 2	52	5260	12.47	13.50	1.267	98.35	1.017	0.06	0.185	0.238
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 2	64	5320	12.39	13.50	1.291	98.35	1.017	-0.04	0.183	0.240
	WLAN5GHz	802.11a 6Mbps	Front	0mm	Ant 1	132	5660	11.96	13.00	1.272	98.27	1.018	-0.14	0.283	0.366
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 1	132	5660	11.96	13.00	1.272	98.27	1.018	0.05	0.368	0.476
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 1	100	5500	11.80	13.00	1.320	98.27	1.018	0.09	0.328	0.441
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 1	140	5700	11.48	13.00	1.420	98.27	1.018	-0.07	0.269	0.389
	WLAN5GHz	802.11a 6Mbps	Front	0mm	Ant 2	132	5660	12.11	13.00	1.227	98.35	1.017	-0.03	0.182	0.227
09	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 2	132	5660	12.11	13.00	1.227	98.35	1.017	0.09	0.523	0.653
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 2	100	5500	11.97	13.00	1.267	98.35	1.017	0.02	0.483	0.622
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 2	140	5700	11.97	13.00	1.267	98.35	1.017	-0.11	0.495	0.638
	WLAN5GHz	802.11a 6Mbps	Front	0mm	Ant 1	149	5745	11.88	13.00	1.294	98.62	1.014	-0.05	0.241	0.316
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 1	149	5745	11.88	13.00	1.294	98.62	1.014	-0.05	0.233	0.306
	WLAN5GHz	802.11a 6Mbps	Front	0mm	Ant 1	157	5785	11.66	13.00	1.361	98.62	1.014	0.03	0.218	0.301
	WLAN5GHz	802.11a 6Mbps	Front	0mm	Ant 1	165	5825	11.56	13.00	1.393	98.62	1.014	-0.08	0.205	0.290
	WLAN5GHz	802.11a 6Mbps	Front	0mm	Ant 2	149	5745	12.19	13.00	1.204	98.35	1.017	-0.09	0.215	0.263
10	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 2	149	5745	12.19	13.00	1.204	98.35	1.017	0.05	0.618	0.757
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 2	157	5785	11.88	13.00	1.294	98.35	1.017	0.03	0.561	0.738
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 2	165	5825	11.46	13.00	1.425	98.35	1.017	0.06	0.514	0.745

14.2 Limbs SAR

<WLAN 2.4GHz SAR>

Plor No.	Band	Mode	Test Position	Gap (mm)	Antenna	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)
	WLAN2.4GHz	802.11b 1Mbps	Front	0mm	Ant 1	1	2412	16.72	18.00	1.343	100	1.000	0.03	0.367	0.493
	WLAN2.4GHz	802.11b 1Mbps	Back	0mm	Ant 1	1	2412	16.72	18.00	1.343	100	1.000	-0.12	0.259	0.348
	WLAN2.4GHz	802.11b 1Mbps	Left Side	0mm	Ant 1	1	2412	16.72	18.00	1.343	100	1.000	0.13	0.174	0.234
	WLAN2.4GHz	802.11b 1Mbps	Top Side	0mm	Ant 1	1	2412	16.72	18.00	1.343	100	1.000	-0.19	0.116	0.156
	WLAN2.4GHz	802.11b 1Mbps	Front	0mm	Ant 1	6	2437	16.63	18.00	1.371	100	1.000	0.07	0.378	0.518
	WLAN2.4GHz	802.11b 1Mbps	Front	0mm	Ant 1	11	2462	16.66	18.00	1.361	100	1.000	0.19	0.364	0.496
	WLAN2.4GHz	802.11b 1Mbps	Front	0mm	Ant 2	11	2462	16.87	18.00	1.297	100	1.000	-0.05	0.107	0.139
	WLAN2.4GHz	802.11b 1Mbps	Back	0mm	Ant 2	11	2462	16.87	18.00	1.297	100	1.000	0.12	0.346	0.449
	WLAN2.4GHz	802.11b 1Mbps	Right Side	0mm	Ant 2	11	2462	16.87	18.00	1.297	100	1.000	0.11	0.200	0.259
	WLAN2.4GHz	802.11b 1Mbps	Bottom Side	0mm	Ant 2	11	2462	16.87	18.00	1.297	100	1.000	0.03	0.083	0.108
01	WLAN2.4GHz	802.11b 1Mbps	Back	0mm	Ant 2	1	2412	16.82	18.00	1.312	100	1.000	0.09	0.396	0.520
	WLAN2.4GHz	802.11b 1Mbps	Back	0mm	Ant 2	6	2437	16.76	18.00	1.330	100	1.000	0.01	0.349	0.464

<Bluetooth SAR>

Plor No.	Band	Mode	Test Position	Gap (mm)	Antenna	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)
02	Bluetooth	1Mbps	Front	0mm	Ant 1	39	2441	10.25	10.50	1.059	77.05	1.298	0.02	0.096	0.132
	Bluetooth	1Mbps	Front	0mm	Ant 1	0	2402	9.44	10.50	1.276	77.05	1.298	0.08	0.075	0.124
	Bluetooth	1Mbps	Front	0mm	Ant 1	78	2480	8.77	10.50	1.489	77.05	1.298	-0.16	0.033	0.064



<WLAN 5GHz SAR>

Plat No.	Band	Mode	Test Position	Gap (mm)	Antenna	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)
	WLAN5.3GHz	802.11a 6Mbps	Front	0mm	Ant 1	56	5280	12.13	13.00	1.223	98.27	1.018	-0.1	0.062	0.077
	WLAN5.3GHz	802.11a 6Mbps	Back	0mm	Ant 1	56	5280	12.13	13.00	1.223	98.27	1.018	0.03	0.086	0.107
	WLAN5.3GHz	802.11a 6Mbps	Left Side	0mm	Ant 1	56	5280	12.13	13.00	1.223	98.27	1.018	-0.06	0.158	0.197
	WLAN5.3GHz	802.11a 6Mbps	Top Side	0mm	Ant 1	56	5280	12.13	13.00	1.223	98.27	1.018	0.06	0.039	0.049
03	WLAN5.3GHz	802.11a 6Mbps	Left Side	0mm	Ant 1	52	5260	12.03	13.00	1.250	98.27	1.018	-0.08	0.164	0.209
	WLAN5.3GHz	802.11a 6Mbps	Left Side	0mm	Ant 1	64	5320	12.06	13.00	1.242	98.27	1.018	0.19	0.130	0.164
	WLAN5.3GHz	802.11a 6Mbps	Front	0mm	Ant 2	56	5280	12.57	13.50	1.238	98.35	1.017	0.13	0.018	0.023
	WLAN5.3GHz	802.11a 6Mbps	Back	0mm	Ant 2	56	5280	12.57	13.50	1.238	98.35	1.017	-0.02	0.055	0.069
	WLAN5.3GHz	802.11a 6Mbps	Right Side	0mm	Ant 2	56	5280	12.57	13.50	1.238	98.35	1.017	0.06	0.057	0.072
	WLAN5.3GHz	802.11a 6Mbps	Bottom Side	0mm	Ant 2	56	5280	12.57	13.50	1.238	98.35	1.017	-0.03	0.013	0.016
	WLAN5.3GHz	802.11a 6Mbps	Right Side	0mm	Ant 2	52	5260	12.47	13.50	1.267	98.35	1.017	0.11	0.044	0.057
	WLAN5.3GHz	802.11a 6Mbps	Right Side	0mm	Ant 2	64	5320	12.39	13.50	1.291	98.35	1.017	-0.01	0.063	0.083
	WLAN5.5GHz	802.11a 6Mbps	Front	0mm	Ant 1	132	5660	11.96	13.00	1.272	98.27	1.018	-0.14	0.075	0.097
	WLAN5.5GHz	802.11a 6Mbps	Back	0mm	Ant 1	132	5660	11.96	13.00	1.272	98.27	1.018	0.05	0.101	0.131
	WLAN5.5GHz	802.11a 6Mbps	Left Side	0mm	Ant 1	132	5660	11.96	13.00	1.272	98.27	1.018	0.03	0.151	0.195
	WLAN5.5GHz	802.11a 6Mbps	Top Side	0mm	Ant 1	132	5660	11.96	13.00	1.272	98.27	1.018	0.15	0.093	0.120
	WLAN5.5GHz	802.11a 6Mbps	Left Side	0mm	Ant 1	100	5500	11.80	13.00	1.320	98.27	1.018	-0.05	0.160	0.215
	WLAN5.5GHz	802.11a 6Mbps	Left Side	0mm	Ant 1	140	5700	11.48	13.00	1.420	98.27	1.018	0.03	0.145	0.210
	WLAN5.5GHz	802.11a 6Mbps	Front	0mm	Ant 2	132	5660	12.11	13.00	1.227	98.35	1.017	-0.03	0.046	0.057
	WLAN5.5GHz	802.11a 6Mbps	Back	0mm	Ant 2	132	5660	12.11	13.00	1.227	98.35	1.017	0.09	0.111	0.138
	WLAN5.5GHz	802.11a 6Mbps	Right Side	0mm	Ant 2	132	5660	12.11	13.00	1.227	98.35	1.017	0.19	0.195	0.243
	WLAN5.5GHz	802.11a 6Mbps	Bottom Side	0mm	Ant 2	132	5660	12.11	13.00	1.227	98.35	1.017	0.15	0.015	0.019
	WLAN5.5GHz	802.11a 6Mbps	Right Side	0mm	Ant 2	100	5500	11.97	13.00	1.267	98.35	1.017	-0.16	0.143	0.184
04	WLAN5.5GHz	802.11a 6Mbps	Right Side	0mm	Ant 2	140	5700	11.97	13.00	1.267	98.35	1.017	-0.06	0.230	0.296
	WLAN5.8GHz	802.11a 6Mbps	Front	0mm	Ant 1	149	5745	11.88	13.00	1.294	98.62	1.014	-0.05	0.064	0.084
	WLAN5.8GHz	802.11a 6Mbps	Back	0mm	Ant 1	149	5745	11.88	13.00	1.294	98.62	1.014	-0.05	0.067	0.088
	WLAN5.8GHz	802.11a 6Mbps	Left Side	0mm	Ant 1	149	5745	11.88	13.00	1.294	98.62	1.014	-0.07	0.119	0.156
	WLAN5.8GHz	802.11a 6Mbps	Top Side	0mm	Ant 1	149	5745	11.88	13.00	1.294	98.62	1.014	0.01	0.063	0.083
	WLAN5.8GHz	802.11a 6Mbps	Left Side	0mm	Ant 1	157	5785	11.66	13.00	1.361	98.62	1.014	-0.09	0.144	0.199
	WLAN5.8GHz	802.11a 6Mbps	Left Side	0mm	Ant 1	165	5825	11.56	13.00	1.393	98.62	1.014	-0.05	0.114	0.161
	WLAN5.8GHz	802.11a 6Mbps	Front	0mm	Ant 2	149	5745	12.19	13.00	1.204	98.35	1.017	-0.09	0.064	0.078
	WLAN5.8GHz	802.11a 6Mbps	Back	0mm	Ant 2	149	5745	12.19	13.00	1.204	98.35	1.017	0.05	0.140	0.171
05	WLAN5.8GHz	802.11a 6Mbps	Right Side	0mm	Ant 2	149	5745	12.19	13.00	1.204	98.35	1.017	-0.04	0.295	0.361
	WLAN5.8GHz	802.11a 6Mbps	Bottom Side	0mm	Ant 2	149	5745	12.19	13.00	1.204	98.35	1.017	0.06	0.008	0.010
	WLAN5.8GHz	802.11a 6Mbps	Right Side	0mm	Ant 2	157	5785	11.88	13.00	1.294	98.35	1.017	0.18	0.238	0.313
	WLAN5.8GHz	802.11a 6Mbps	Right Side	0mm	Ant 2	165	5825	11.46	13.00	1.425	98.35	1.017	0.08	0.243	0.352

15. Simultaneous Transmission Analysis

NO.	Simultaneous Transmission Configurations	Handheld wireless data terminal	
		Body-worn	Limbs
1.	2.4GHz WLAN Ant1 + 2.4GHz WLAN Ant2	Yes	Yes
2.	5 GHz WLAN Ant1 + 5 GHz WLAN Ant2	Yes	Yes
3.	5 GHz WLAN Ant1 + Bluetooth	Yes	Yes
4.	5 GHz WLAN Ant2 + Bluetooth	Yes	Yes
5.	5 GHz WLAN Ant1 + 5 GHz WLAN Ant2 + Bluetooth	Yes	Yes
6.	2.4GHz WLAN Ant1 + 5 GHz WLAN Ant2	Yes	Yes

General Note:

- WLAN 2.4GHz and Bluetooth share the same antenna so can't transmit simultaneously.
- According to the character of EUT, WLAN5GHz and Bluetooth can transmit simultaneously.
- According to the character of EUT, WLAN2.4GHz and Bluetooth can't transmit simultaneously.
- For simultaneously analysis, since the SAR summation of 3 transmitters can cover others combination of 2 transmitters, therefore in this section did not additional to evaluate 2TX combination of simultaneously transmission.
- Per KDB 447498 D01v06, simultaneous transmission SAR is compliant if,
 - 10g Scalar SAR summation < 4.0W/kg.
 - $SPLSR = (SAR1 + SAR2)^{1.5} / (\text{min. separation distance, mm})$, 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 $SPLSR \leq 0.10$ for 10g SAR, simultaneously transmission SAR measurement is not necessary.
 - Simultaneously transmission SAR measurement, and the reported multi-band 10g SAR < 4.0W/kg.

15.1 Body-worn Exposure Conditions

Exposure Position	1	2	3	4	5	1+4	3+4+5	1+2
	2.4GHz WLAN Ant 1 1g SAR (W/kg)	2.4GHz WLAN Ant 2 1g SAR (W/kg)	5GHz WLAN Ant 1 1g SAR (W/kg)	5GHz WLAN Ant 2 1g SAR (W/kg)	Bluetooth Ant 1 1g SAR (W/kg)	Summed 1g SAR (W/kg)	Summed 1g SAR (W/kg)	Summed 1g SAR (W/kg)
Front	0.119	0.029	0.366	0.263	0.271	0.15	0.63	0.37
Back	0.085	0.102	0.476	0.757	0.271	0.19	1.23	0.48

15.2 Limbs Exposure Conditions

Exposure Position	1	2	3	4	5	1+4	3+4+5	1+2
	2.4GHz WLAN Ant 1 10g SAR (W/kg)	2.4GHz WLAN Ant 2 10g SAR (W/kg)	5GHz WLAN Ant 1 10g SAR (W/kg)	5GHz WLAN Ant 2 10g SAR (W/kg)	Bluetooth Ant 1 10g SAR (W/kg)	Summed 10g SAR (W/kg)	Summed 10g SAR (W/kg)	Summed 10g SAR (W/kg)
Front	0.518	0.139	0.097	0.078	0.132	0.60	0.31	0.66
Back	0.348	0.520	0.131	0.171	0.132	0.52	0.43	0.87
Left side	0.234		0.215		0.132	0.23	0.35	0.23
Right side		0.259		0.361	0.132	0.36	0.49	0.26
Top side	0.156		0.120		0.132	0.16	0.25	0.16
Bottom side		0.108		0.019	0.132	0.02	0.15	0.11

Test Engineer : Nick Hu, Seven Xu, Bruce Li



16. 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.



17. References

- [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 248227 D01 v02r02, "SAR Guidance for IEEE 802.11 (WiFi) Transmitters", Oct 2015.
- [6] FCC KDB 447498 D01 v06, "Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies", Oct 2015
- [7] FCC KDB 865664 D01 v01r04, "SAR Measurement Requirements for 100 MHz to 6 GHz", Aug 2015.
- [8] FCC KDB 865664 D02 v01r02, "RF Exposure Compliance Reporting and Documentation Considerations" Oct 2015.



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; $\sigma = 1.774$ S/m; $\epsilon_r = 39.476$; $\rho = 1000$ kg/m³

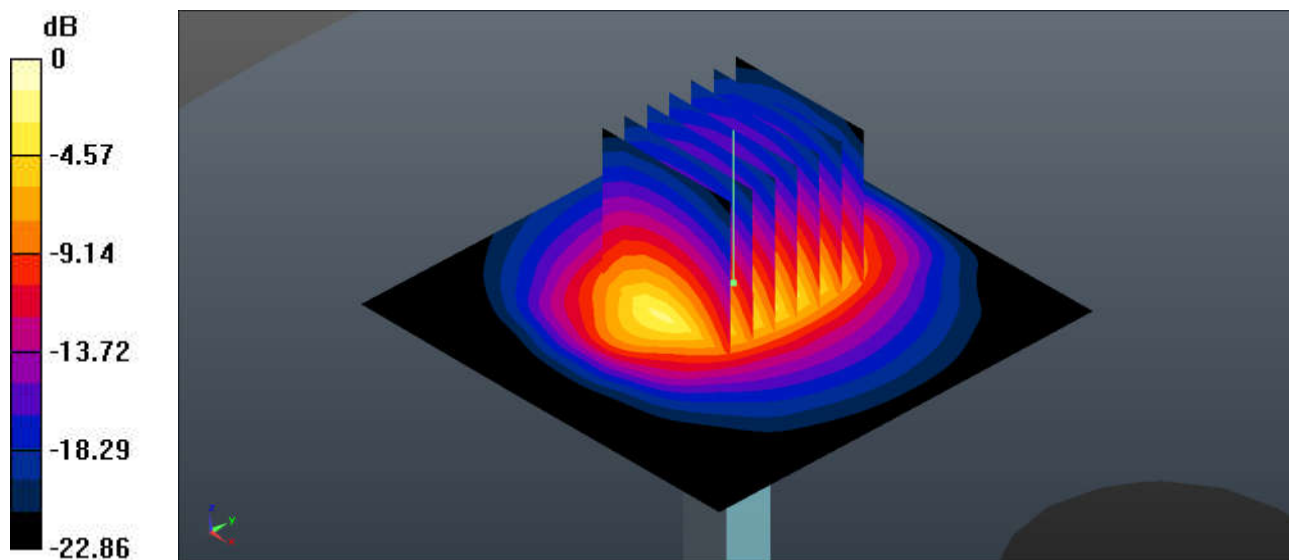
Ambient Temperature : 23.2 °C; Liquid Temperature : 22.8 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3843; ConvF(6.85, 6.85, 6.85); Calibrated: 2020.9.23
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn799; Calibrated: 2021.3.26
- Phantom: SAM Twin Phantom; Type: SAM Twin; Serial: TP-1754
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

Pin=50mW/Area Scan (71x71x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 4.77 W/kg

Pin=50mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 43.33 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 6.02 W/kg
SAR(1 g) = 2.74 W/kg; SAR(10 g) = 1.25 W/kg
Maximum value of SAR (measured) = 4.73 W/kg



0 dB = 4.73 W/kg = 6.75 dBW/kg

System Check_Head_5250MHz

DUT: D5GHzV2 - SN:1113

Communication System: UID 0, CW (0); Frequency: 5250 MHz; Duty Cycle: 1:1
Medium: HSL_5000 Medium parameters used: $f = 5250 \text{ MHz}$; $\sigma = 4.69 \text{ S/m}$; $\epsilon_r = 36.422$; $\rho = 1000 \text{ kg/m}^3$

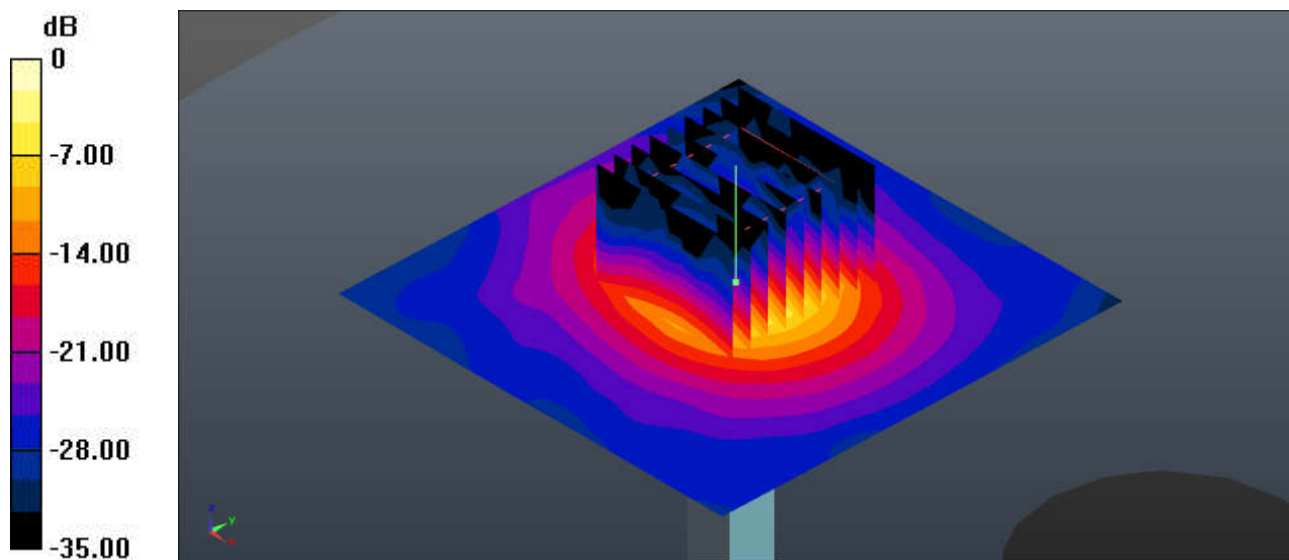
Ambient Temperature : 23.3 °C; Liquid Temperature : 22.6 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3843; ConvF(4.66, 4.66, 4.66); Calibrated: 2020.9.23
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn799; Calibrated: 2021.3.26
- Phantom: SAM Twin Phantom; Type: SAM Twin; Serial: TP-1754
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

Pin=50mW/Area Scan (91x91x1): Interpolated grid: $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$
Maximum value of SAR (interpolated) = 11.0 W/kg

Pin=50mW/Zoom Scan (9x9x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$
Reference Value = 49.13 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 18.8 W/kg
SAR(1 g) = 4.25 W/kg; SAR(10 g) = 1.23 W/kg
Maximum value of SAR (measured) = 11.6 W/kg



0 dB = 11.6 W/kg = 10.64 dBW/kg

System Check_Head_5600MHz

DUT: D5GHzV2 - SN:1113

Communication System: UID 0, CW (0); Frequency: 5600 MHz; Duty Cycle: 1:1
Medium: HSL_5000 Medium parameters used: $f = 5600$ MHz; $\sigma = 5.034$ S/m; $\epsilon_r = 35.819$; $\rho = 1000$ kg/m³

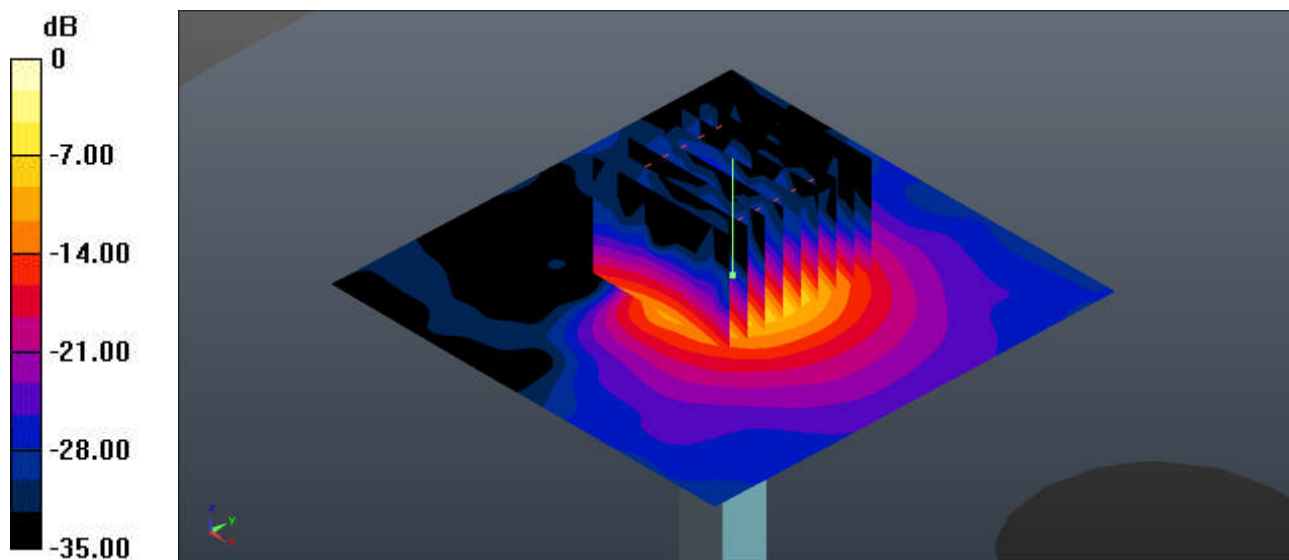
Ambient Temperature : 23.2 °C; Liquid Temperature : 22.6 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3843; ConvF(4.3, 4.3, 4.3); Calibrated: 2020.9.23
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn799; Calibrated: 2021.3.26
- Phantom: SAM Twin Phantom; Type: SAM Twin; Serial: TP-1754
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

Pin=50mW/Area Scan (91x91x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 16.6 W/kg

Pin=50mW/Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 49.74 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 22.0 W/kg
SAR(1 g) = 4.36 W/kg; SAR(10 g) = 1.26 W/kg
Maximum value of SAR (measured) = 12.7 W/kg



0 dB = 12.7 W/kg = 11.04 dBW/kg

System Check_Head_5750MHz

DUT: D5GHzV2 - SN:1113

Communication System: UID 0, CW (0); Frequency: 5750 MHz; Duty Cycle: 1:1
Medium: HSL_5000 Medium parameters used: $f = 5750 \text{ MHz}$; $\sigma = 5.281 \text{ S/m}$; $\epsilon_r = 35.507$; $\rho = 1000 \text{ kg/m}^3$

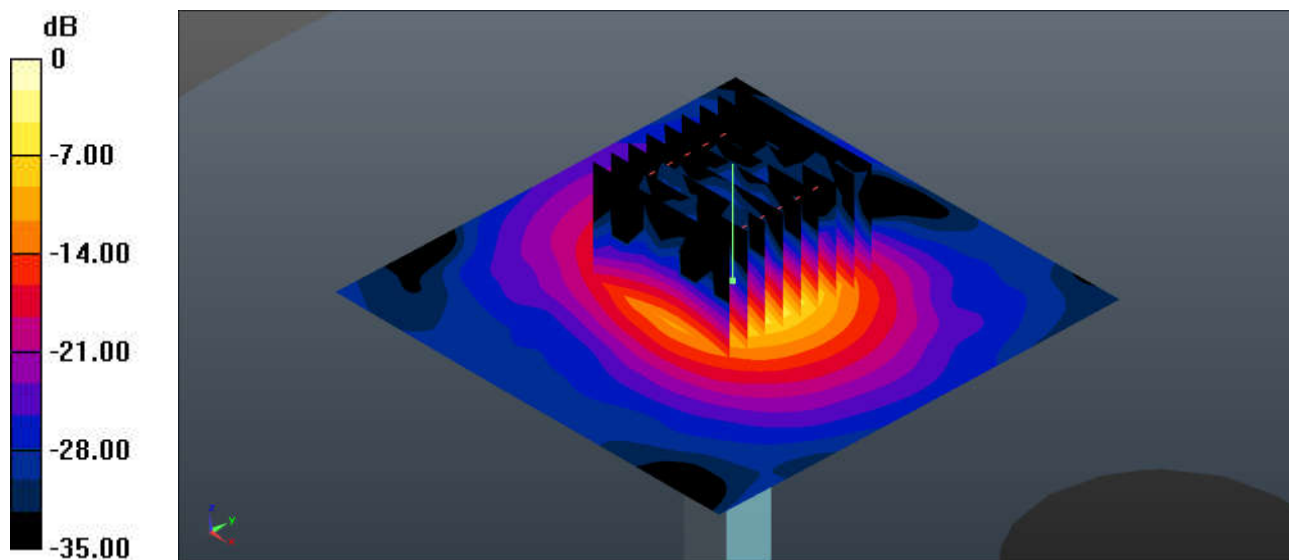
Ambient Temperature : 23.4 °C; Liquid Temperature : 22.7 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3843; ConvF(4.35, 4.35, 4.35); Calibrated: 2020.9.23
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn799; Calibrated: 2021.3.26
- Phantom: SAM Twin Phantom; Type: SAM Twin; Serial: TP-1754
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

Pin=50mW/Area Scan (91x91x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 11.4 W/kg

Pin=50mW/Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 46.94 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 21.0 W/kg
SAR(1 g) = 4.31 W/kg; SAR(10 g) = 1.21 W/kg
Maximum value of SAR (measured) = 11.9 W/kg



0 dB = 11.9 W/kg = 10.76 dBW/kg

System Check_Head_2450MHz

DUT: D2450V2 - SN:908

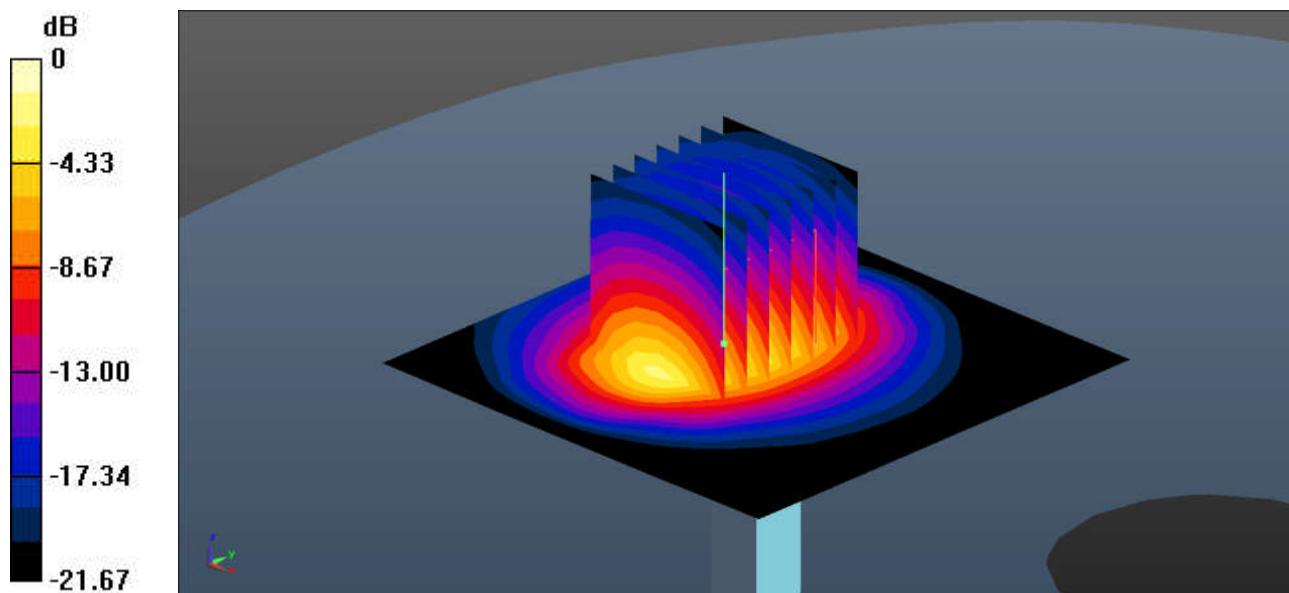
Communication System: UID 0, CW (0); Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: HSL_2450 Medium parameters used: $f = 2450$ MHz; $\sigma = 1.81$ S/m; $\epsilon_r = 38622.$; $\rho = 1000$ kg/m³
Ambient Temperature : 23.3 °C; Liquid Temperature : 22.6 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN7592; ConvF(7.53, 7.53, 7.53); Calibrated: 2021.6.24
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2021.6.18
- Phantom: SAM Twin Phantom; Type: SAM Twin; Serial: TP-1697
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

Pin=50mW/Area Scan (71x71x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 4.63 W/kg

Pin=50mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 37.69 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 5.52 W/kg
SAR(1 g) = 2.68 W/kg; SAR(10 g) = 1.25 W/kg
Maximum value of SAR (measured) = 4.49 W/kg



0 dB = 4.49 W/kg = 6.52 dBW/kg

System Check_Head_5250MHz

DUT: D5GHzV2 - SN:1113

Communication System: UID 0, CW (0); Frequency: 5250 MHz; Duty Cycle: 1:1

Medium: HSL_5000 Medium parameters used: $f = 5250$ MHz; $\sigma = 4.594$ S/m; $\epsilon_r = 36.251$; $\rho = 1000$ kg/m³

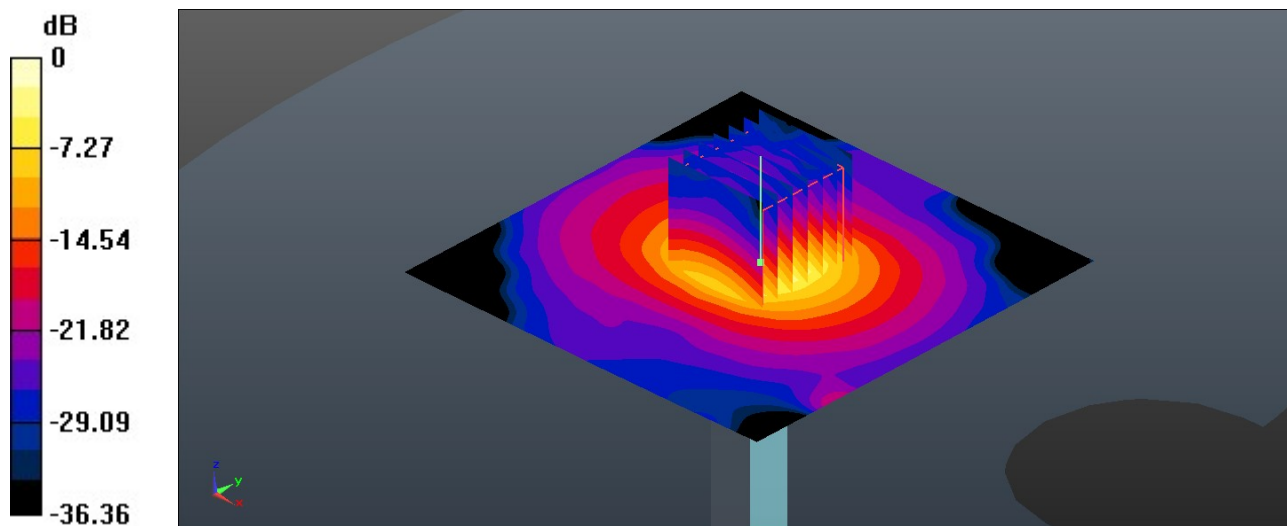
Ambient Temperature : 23.2 °C; Liquid Temperature : 22.6 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN7592; ConvF(5.38, 5.38, 5.38); Calibrated: 2021.6.24
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2021.6.18
- Phantom: SAM Twin Phantom; Type: SAM Twin; Serial: TP-1697
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

Pin=50mW/Area Scan (91x91x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 8.52 W/kg

Pin=50mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 46.57 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 15.3 W/kg
SAR(1 g) = 3.84 W/kg; SAR(10 g) = 1.1 W/kg
Maximum value of SAR (measured) = 9.63 W/kg



0 dB = 9.63 W/kg = 9.84 dBW/kg

System Check_Head_5600MHz

DUT: D5GHzV2 - SN:1113

Communication System: UID 0, CW (0); Frequency: 5600 MHz; Duty Cycle: 1:1
Medium: HSL_5000 Medium parameters used: $f = 5600$ MHz; $\sigma = 4.973$ S/m; $\epsilon_r = 35.717$; $\rho = 1000$ kg/m³

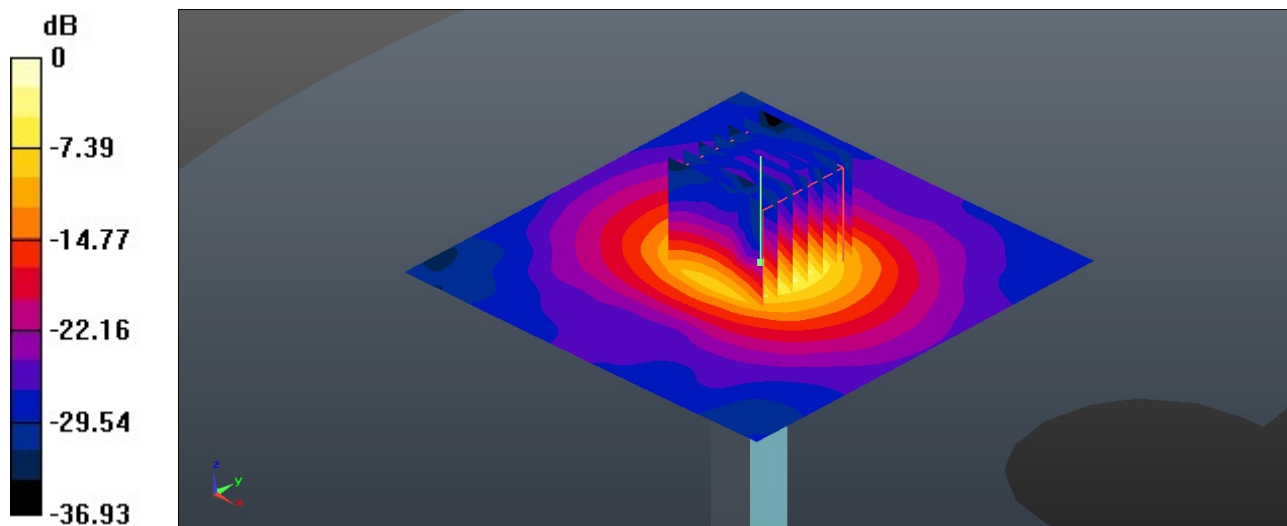
Ambient Temperature : 23.3 °C; Liquid Temperature : 22.7 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN7592; ConvF(4.68, 4.68, 4.68); Calibrated: 2021.6.24
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2021.6.18
- Phantom: SAM Twin Phantom; Type: SAM Twin; Serial: TP-1697
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

Pin=50mW/Area Scan (91x91x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 10.0 W/kg

Pin=50mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 48.75 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 18.9 W/kg
SAR(1 g) = 4.28 W/kg; SAR(10 g) = 1.22 W/kg
Maximum value of SAR (measured) = 11.1 W/kg



0 dB = 11.1 W/kg = 10.45 dBW/kg

System Check_Head_5750MHz

DUT: D5GHzV2 - SN:1113

Communication System: UID 0, CW (0); Frequency: 5750 MHz; Duty Cycle: 1:1
Medium: HSL_5000 Medium parameters used: $f = 5750$ MHz; $\sigma = 5.148$ S/m; $\epsilon_r = 35.533$; $\rho = 1000$ kg/m³

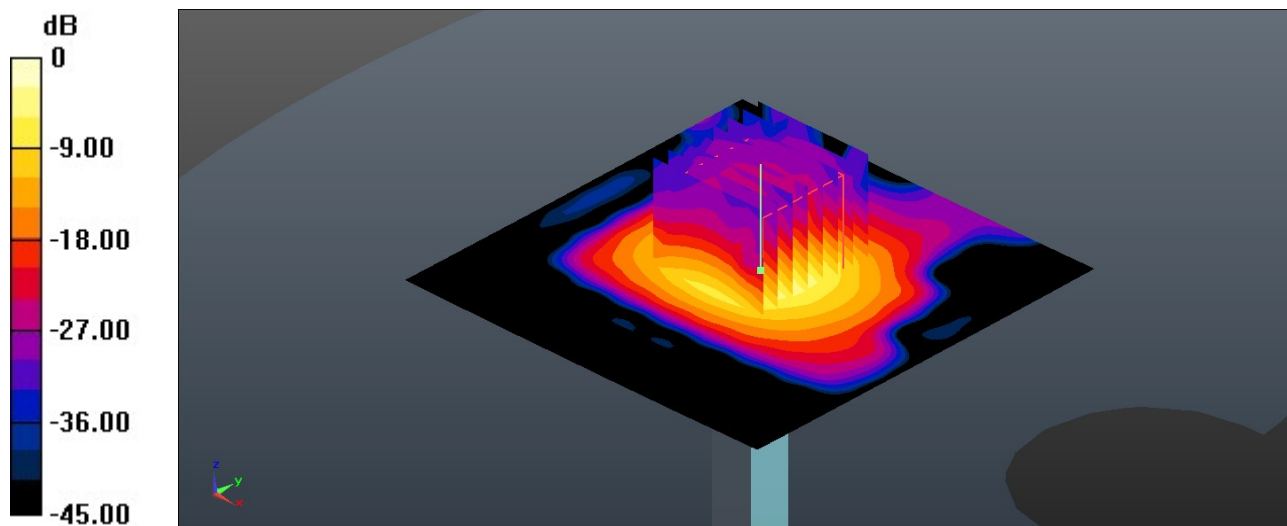
Ambient Temperature : 23.3 °C; Liquid Temperature : 22.6 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN7592; ConvF(4.82, 4.82, 4.82); Calibrated: 2021.6.24
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2021.6.18
- Phantom: SAM Twin Phantom; Type: SAM Twin; Serial: TP-1697
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

Pin=50mW/Area Scan (91x91x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 9.37 W/kg

Pin=50mW/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 46.81 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 18.4 W/kg
SAR(1 g) = 4.06 W/kg; SAR(10 g) = 1.11 W/kg
Maximum value of SAR (measured) = 10.6 W/kg



0 dB = 10.6 W/kg = 10.25 dBW/kg



Appendix B. Plots of High SAR Measurement

The plots are shown as follows.

06_WLAN2.4GHz_802.11b 1Mbps_Front_10mm_Ch6

Communication System: UID 0, WLAN2.4GHz (0); Frequency: 2437 MHz; Duty Cycle: 1:1
Medium: HSL_2450 Medium parameters used: $f = 2437$ MHz; $\sigma = 1.802$ S/m; $\epsilon_r = 38.671$; $\rho = 1000$ kg/m³

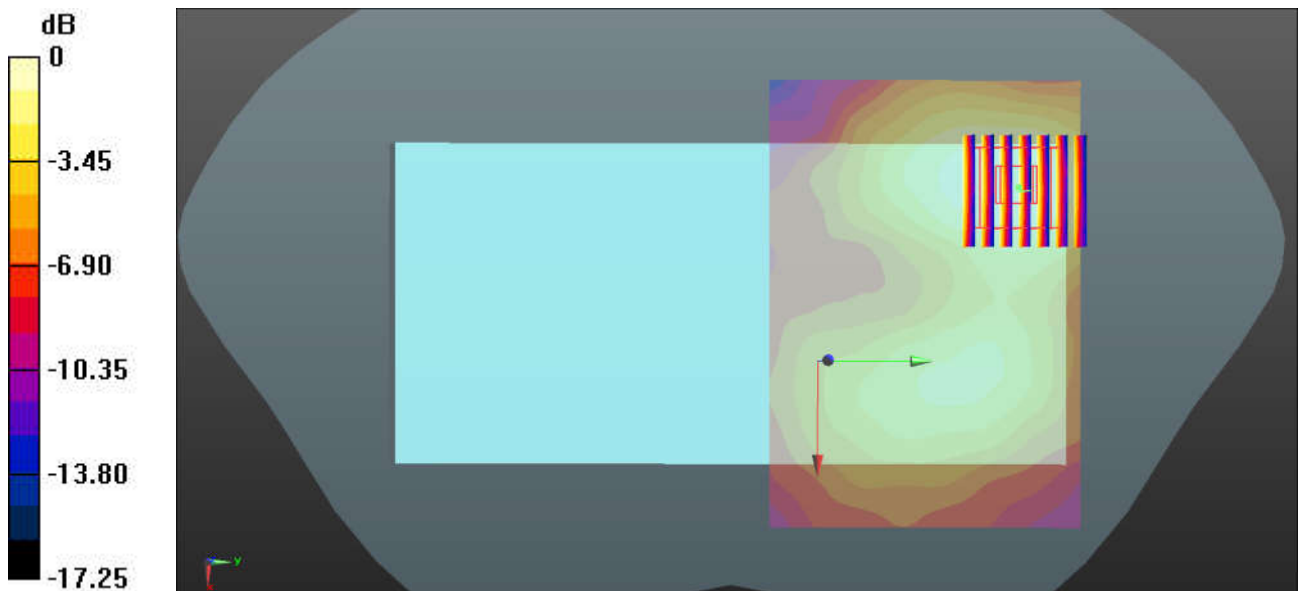
Ambient Temperature : 23.3 °C; Liquid Temperature : 22.6 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN7592; ConvF(7.53, 7.53, 7.53); Calibrated: 2021.6.24
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2021.6.18
- Phantom: SAM Twin Phantom; Type: SAM Twin; Serial: TP-1697
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

Area Scan (101x71x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.132 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 8.885 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 0.156 W/kg
SAR(1 g) = 0.087 W/kg; SAR(10 g) = 0.050 W/kg
Maximum value of SAR (measured) = 0.128 W/kg



0 dB = 0.128 W/kg = -8.93 dBW/kg

07_Bluetooth_1Mbps_Front_0mm_Ch39

Communication System: UID 0, Bluetooth (0); Frequency: 2441 MHz; Duty Cycle: 1:1.298
Medium: HSL_2450 Medium parameters used: $f = 2441$ MHz; $\sigma = 1.768$ S/m; $\epsilon_r = 39.5$; $\rho = 1000$ kg/m³

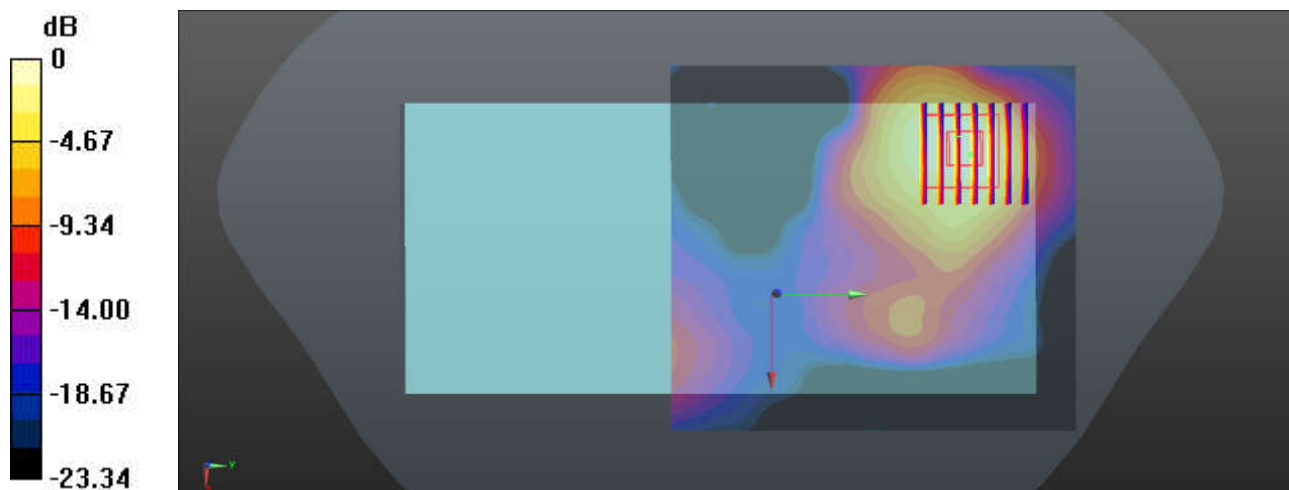
Ambient Temperature : 23.2 °C; Liquid Temperature : 22.8 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3843; ConvF(6.85, 6.85, 6.85); Calibrated: 2020.9.23
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn799; Calibrated: 2021.3.26
- Phantom: SAM Twin Phantom; Type: SAM Twin; Serial: TP-1754
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

Area Scan (91x101x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.253 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.318 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 0.378 W/kg
SAR(1 g) = 0.197 W/kg; SAR(10 g) = 0.096 W/kg
Maximum value of SAR (measured) = 0.246 W/kg



0 dB = 0.246 W/kg = -6.09 dBW/kg

08_WLAN5G_802.11a 6Mbps_Back_0mm_Ch56

Communication System: UID 0, WLAN5GHz (0); Frequency: 5280 MHz; Duty Cycle: 1:1.018
Medium: HSL_5000 Medium parameters used: $f = 5280$ MHz; $\sigma = 4.709$ S/m; $\epsilon_r = 36.528$; $\rho = 1000$ kg/m³

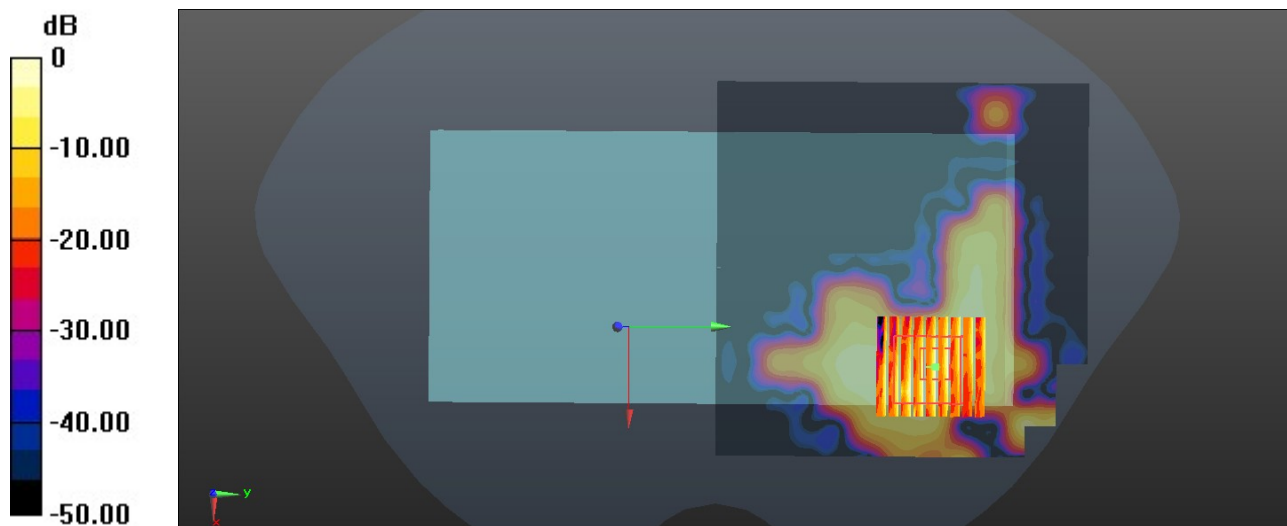
Ambient Temperature : 23.3 °C; Liquid Temperature : 22.6 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3843; ConvF(4.66, 4.66, 4.66); Calibrated: 2020.9.23
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn799; Calibrated: 2021.3.26
- Phantom: SAM Twin Phantom; Type: SAM Twin; Serial: TP-1754
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

Area Scan (121x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.862 W/kg

Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 10.06 V/m; Power Drift = 0.03dB
Peak SAR (extrapolated) = 3.57 W/kg
SAR(1 g) = 0.279 W/kg; SAR(10 g) = 0.086 W/kg
Maximum value of SAR (measured) = 0.889 W/kg



0 dB = 0.889 W/kg = -0.51 dBW/kg

09_WLAN5G_802.11a 6Mbps_Back_0mm_Ch132

Communication System: UID 0, WLAN5GHz (0); Frequency: 5660 MHz; Duty Cycle: 1:1.017
Medium: HSL_5000 Medium parameters used: $f = 5660$ MHz; $\sigma = 5.17$ S/m; $\epsilon_r = 35.757$; $\rho = 1000$ kg/m³

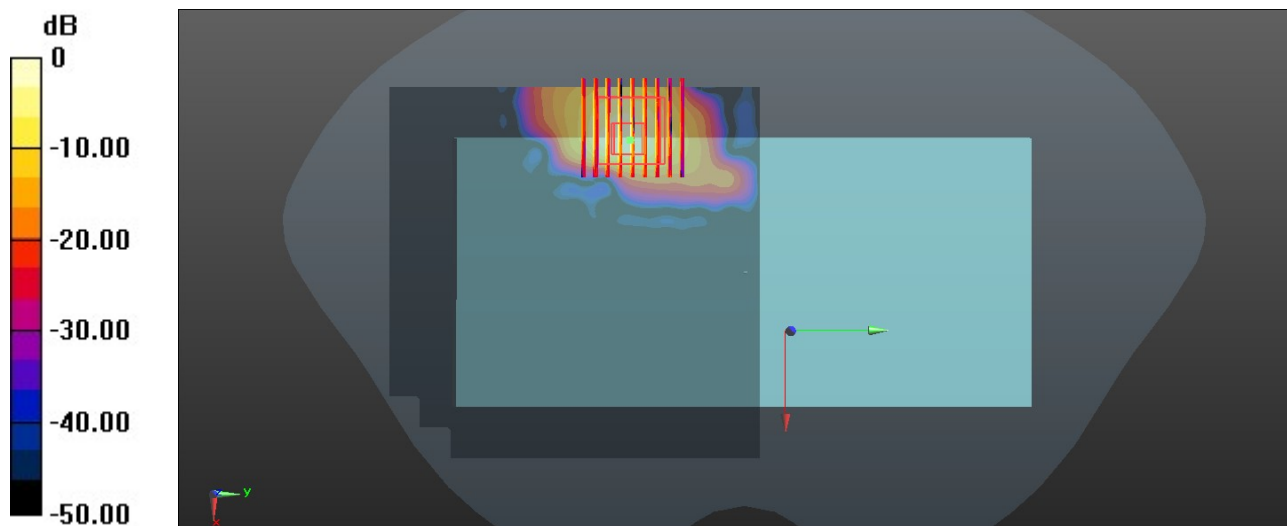
Ambient Temperature : 23.3 °C; Liquid Temperature : 22.6 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3843; ConvF(4.3, 4.3, 4.3); Calibrated: 2020.9.23
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn799; Calibrated: 2021.3.26
- Phantom: SAM Twin Phantom; Type: SAM Twin; Serial: TP-1754
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

Area Scan (121x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.56 W/kg

Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 15.74 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 1.83 W/kg
SAR(1 g) = 0.523 W/kg; SAR(10 g) = 0.111 W/kg
Maximum value of SAR (measured) = 1.51 W/kg



0 dB = 1.51 W/kg = 1.79 dBW/kg

10_WLAN5G_802.11a 6Mbps_Back_0mm_Ch149

Communication System: UID 0, WLAN5GHz (0); Frequency: 5745 MHz; Duty Cycle: 1:1.018
Medium: HSL_5000 Medium parameters used: $f = 5745$ MHz; $\sigma = 5.26$ S/m; $\epsilon_r = 35.487$; $\rho = 1000$ kg/m³

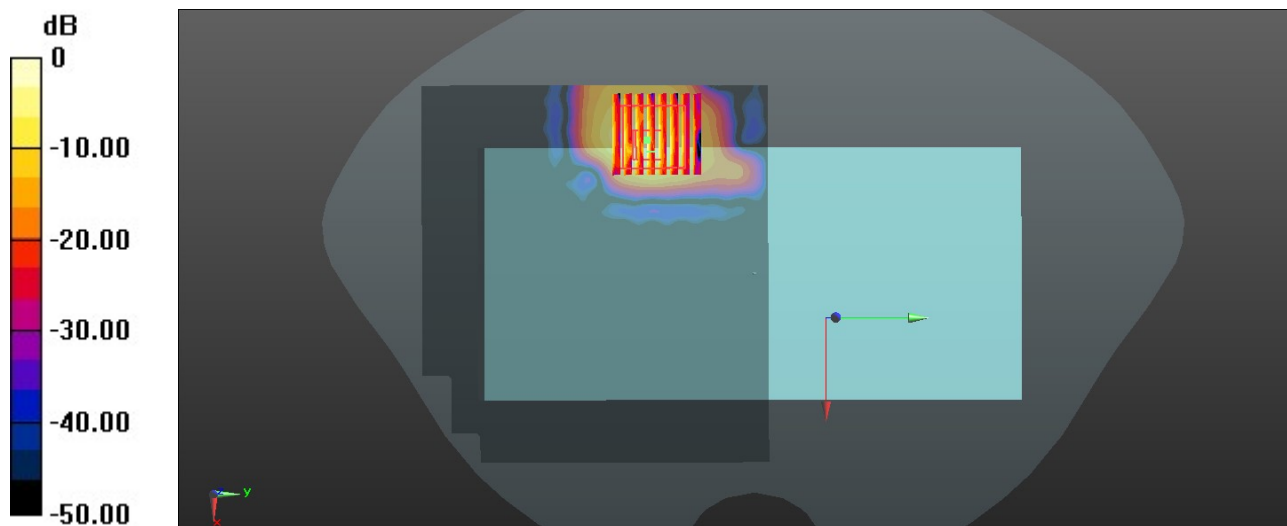
Ambient Temperature : 23.4 °C; Liquid Temperature : 22.7 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3843; ConvF(4.35, 4.35, 4.35); Calibrated: 2020.9.23
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn799; Calibrated: 2021.3.26
- Phantom: SAM Twin Phantom; Type: SAM Twin; Serial: TP-1754
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

Area Scan (131x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.41 W/kg

Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 17.25 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 2.78 W/kg
SAR(1 g) = 0.618 W/kg; SAR(10 g) = 0.140 W/kg
Maximum value of SAR (measured) = 1.34 W/kg



0 dB = 1.34 W/kg = 1.27 dBW/kg

01_WLAN2.4GHz_802.11b 1Mbps_Back_0mm_Ch1

Communication System: UID 0, WLAN2.4GHz (0); Frequency: 2412 MHz; Duty Cycle: 1:1
Medium: HSL_2450 Medium parameters used: $f = 2412$ MHz; $\sigma = 1.749$ S/m; $\epsilon_r = 39.543$; $\rho = 1000$ kg/m³

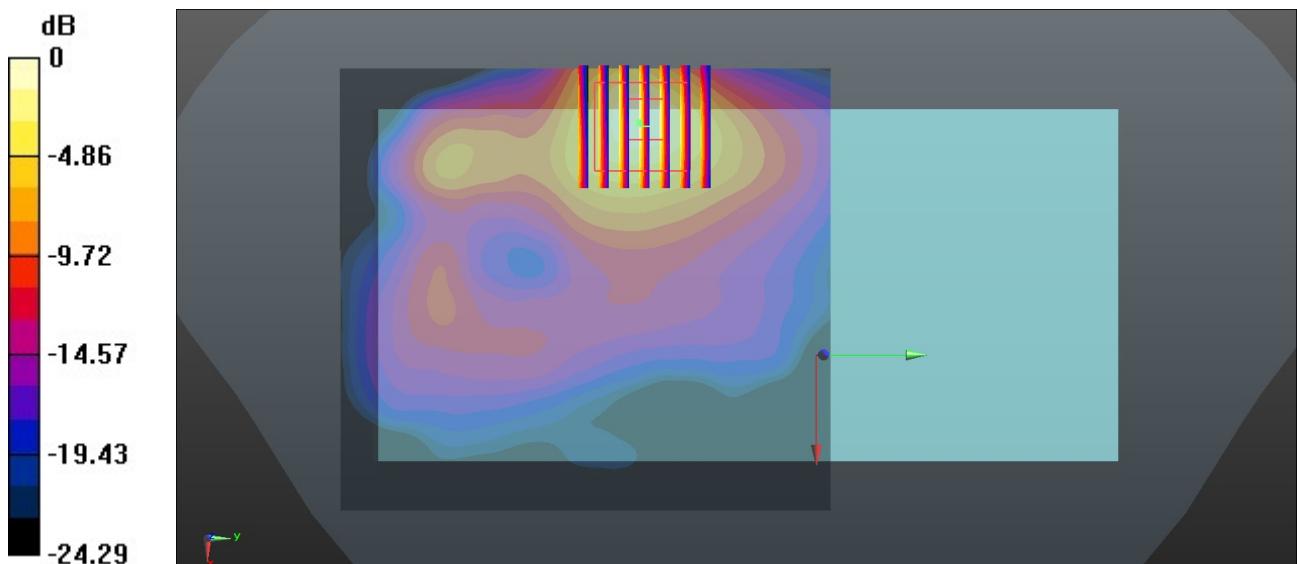
Ambient Temperature : 23.2 °C; Liquid Temperature : 22.8 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3843; ConvF(6.85, 6.85, 6.85); Calibrated: 2020.9.23
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn799; Calibrated: 2021.3.26
- Phantom: SAM Twin Phantom; Type: SAM Twin; Serial: TP-1754
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

Area Scan (91x101x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 1.65 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 29.73 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 2.20 W/kg
SAR(1 g) = 0.892 W/kg; SAR(10 g) = 0.396 W/kg
Maximum value of SAR (measured) = 1.59 W/kg



0 dB = 1.59 W/kg = 2.01 dBW/kg

02_Bluetooth_1Mbps_Front_0mm_Ch39

Communication System: UID 0, Bluetooth (0); Frequency: 2441 MHz; Duty Cycle: 1:1.298
Medium: HSL_2450 Medium parameters used: $f = 2441$ MHz; $\sigma = 1.768$ S/m; $\epsilon_r = 39.5$; $\rho = 1000$ kg/m³

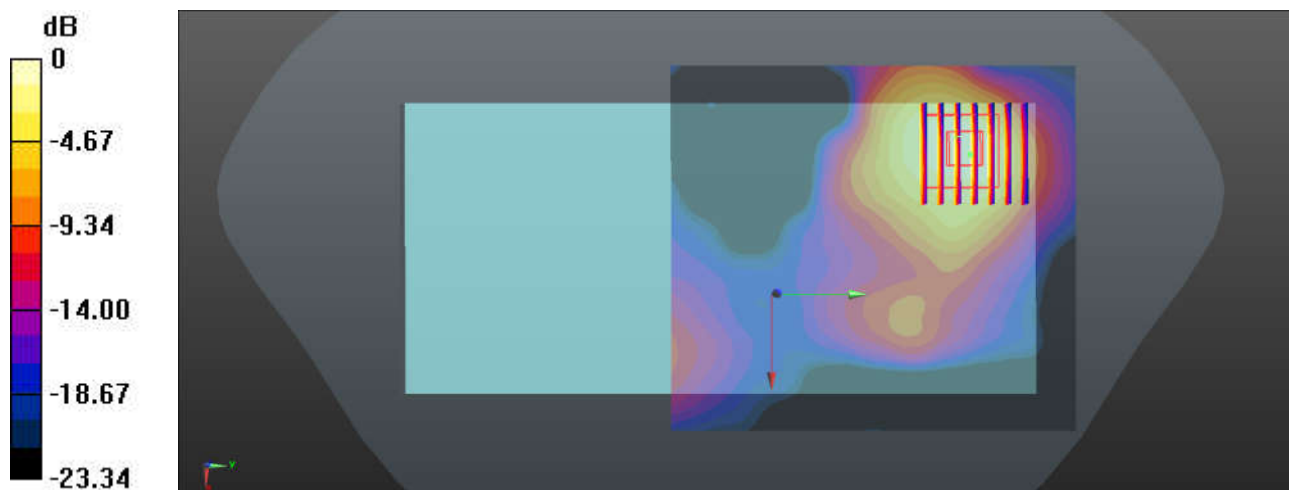
Ambient Temperature : 23.2 °C; Liquid Temperature : 22.8 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3843; ConvF(6.85, 6.85, 6.85); Calibrated: 2020.9.23
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn799; Calibrated: 2021.3.26
- Phantom: SAM Twin Phantom; Type: SAM Twin; Serial: TP-1754
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

Area Scan (91x101x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.253 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.318 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 0.378 W/kg
SAR(1 g) = 0.197 W/kg; SAR(10 g) = 0.096 W/kg
Maximum value of SAR (measured) = 0.246 W/kg



0 dB = 0.246 W/kg = -6.09 dBW/kg

03_WLAN5GHz_802.11a 6Mbps_Left Side_0mm_Ch52

Communication System: UID 0, WLAN5GHz (0); Frequency: 5260 MHz; Duty Cycle: 1:1.018
Medium: HSL_5000 Medium parameters used: $f = 5260$ MHz; $\sigma = 4.717$ S/m; $\epsilon_r = 36.463$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.3 °C; Liquid Temperature : 22.6 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3843; ConvF(4.66, 4.66, 4.66); Calibrated: 2020.9.23
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn799; Calibrated: 2021.3.26
- Phantom: SAM Twin Phantom; Type: SAM Twin; Serial: TP-1754
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

Area Scan (51x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 1.92 W/kg

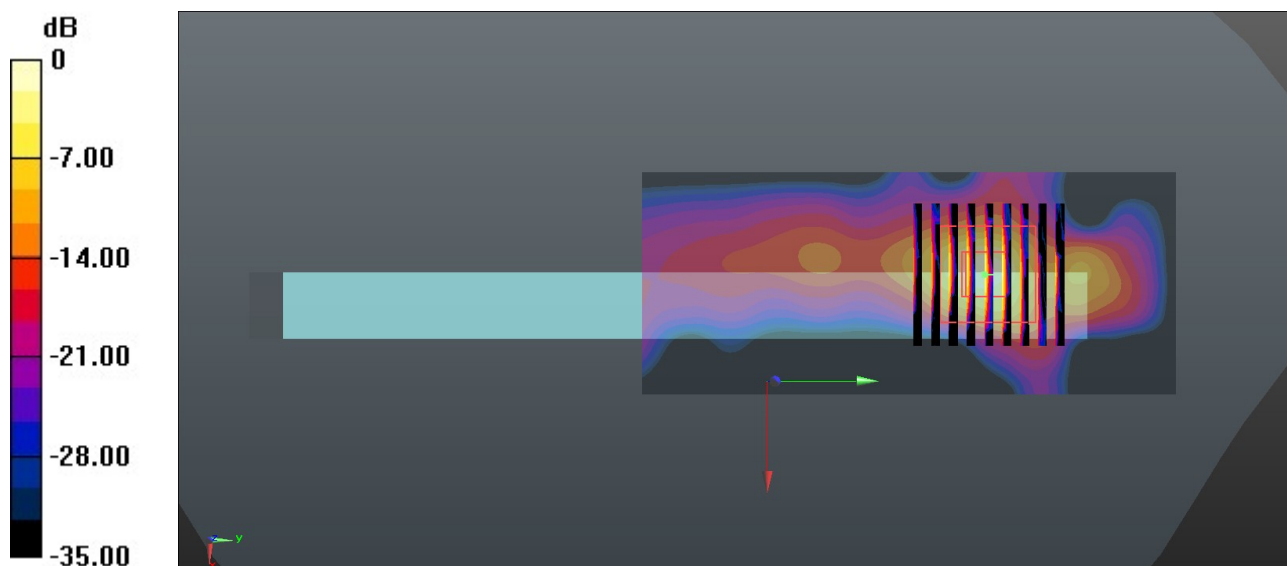
Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 18.78 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 3.73 W/kg

SAR(1 g) = 0.773 W/kg; SAR(10 g) = 0.164 W/kg

Maximum value of SAR (measured) = 2.27 W/kg



0 dB = 2.27 W/kg = 3.56 dBW/kg

04_WLAN5GHz_802.11a 6Mbps_Right Side_0mm_Ch140

Communication System: UID 0, WLAN5GHz (0); Frequency: 5700 MHz; Duty Cycle: 1:1.017
Medium: HSL_5000 Medium parameters used: $f = 5700$ MHz; $\sigma = 5.149$ S/m; $\epsilon_r = 35.638$; $\rho = 1000$ kg/m³

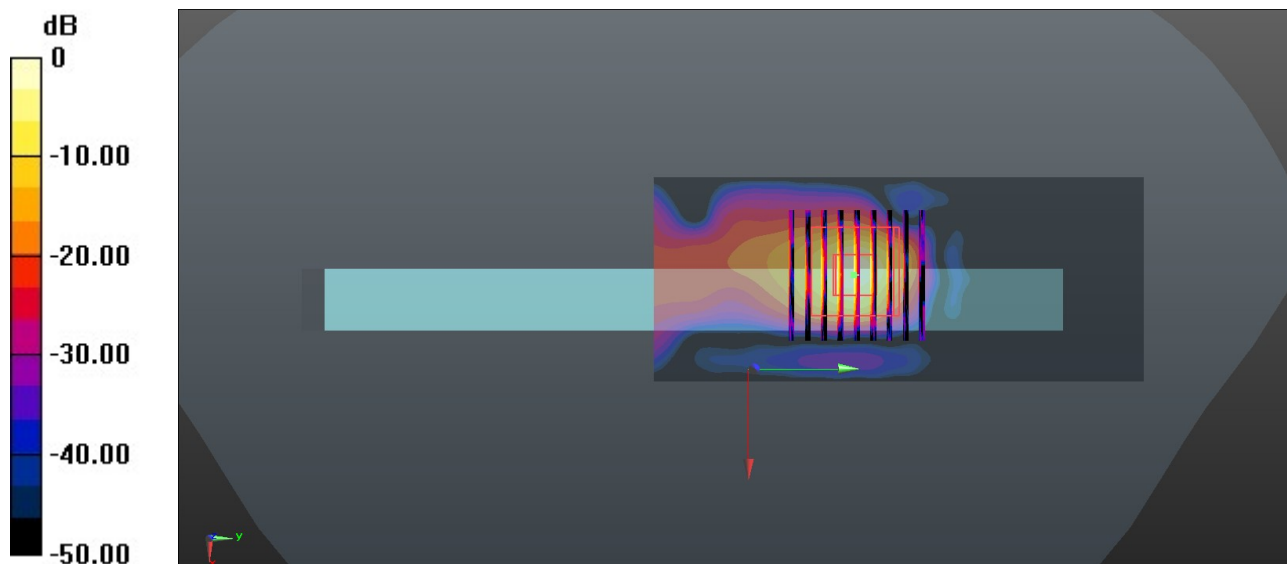
Ambient Temperature : 23.4 °C; Liquid Temperature : 22.7 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3843; ConvF(4.35, 4.35, 4.35); Calibrated: 2020.9.23
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn799; Calibrated: 2021.3.26
- Phantom: SAM Twin Phantom; Type: SAM Twin; Serial: TP-1754
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

Area Scan (51x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 3.37 W/kg

Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 22.03 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 7.57 W/kg
SAR(1 g) = 1.25 W/kg; SAR(10 g) = 0.230 W/kg
Maximum value of SAR (measured) = 4.11 W/kg



0 dB = 4.11 W/kg = 6.14 dBW/kg

05_WLAN5GHz_802.11a 6Mbps_Right Side_0mm_Ch149

Communication System: UID 0, WLAN5GHz (0); Frequency: 5745 MHz; Duty Cycle: 1:1.017
Medium: HSL_5000 Medium parameters used: $f = 5745$ MHz; $\sigma = 5.26$ S/m; $\epsilon_r = 35.487$; $\rho = 1000$ kg/m³

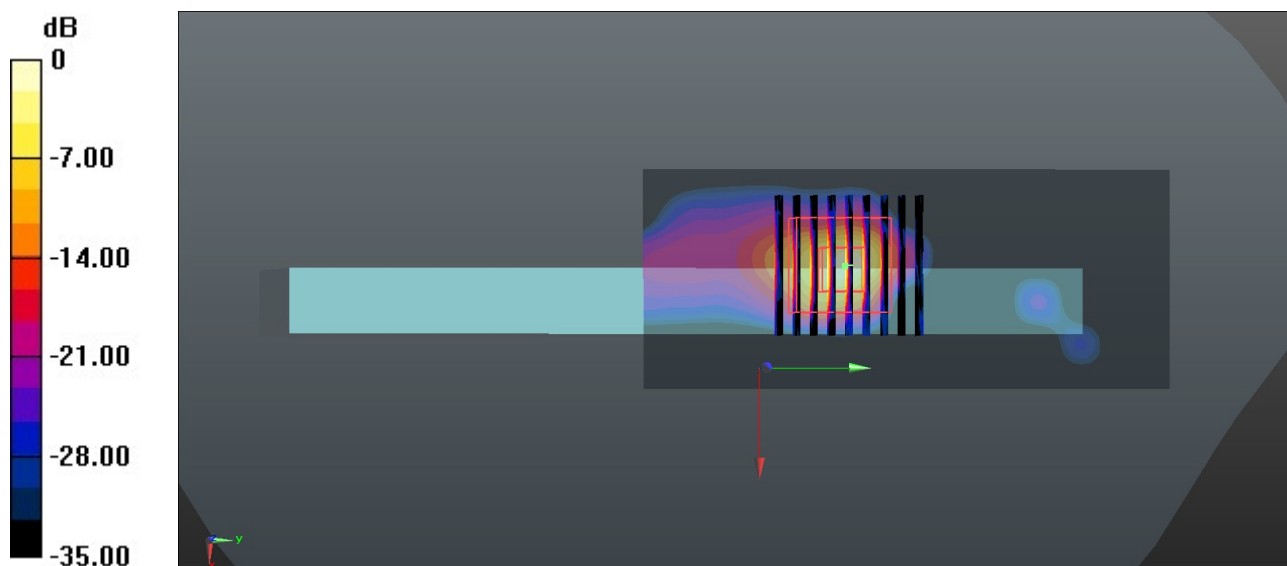
Ambient Temperature : 23.4 °C; Liquid Temperature : 22.7 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3843; ConvF(4.35, 4.35, 4.35); Calibrated: 2020.9.23
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn799; Calibrated: 2021.3.26
- Phantom: SAM Twin Phantom; Type: SAM Twin; Serial: TP-1754
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

Area Scan (51x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 4.86 W/kg

Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 29.71 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 10.3 W/kg
SAR(1 g) = 1.58 W/kg; SAR(10 g) = 0.295 W/kg
Maximum value of SAR (measured) = 5.33 W/kg



0 dB = 5.33 W/kg = 7.27 dBW/kg



Appendix C. DASYS Calibration Certificate

The DASYS calibration certificates are shown as follows.



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中国认可
国际互认
校准
CALIBRATION
CNAS L0570

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E-mail: cttl@chinattl.com http://www.chinattl.cn

Client **Sporton**

Certificate No: **Z19-60087**

CALIBRATION CERTIFICATE

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	106277	20-Aug-18 (CTTL, No.J18X06862)	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.



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CALIBRATION LABORATORY

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E-mail: ctl@chinattl.com <http://www.chinattl.cn>

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM _{x,y,z}
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

- 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
- 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
- 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
- KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

Additional Documentation:

- 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%.



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 \pm 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 \pm 0.2) °C	39.6 \pm 6 %	1.84 mho/m \pm 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 \pm 18.6 % (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 \pm 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 \pm 0.2) °C	53.8 \pm 6 %	2.00 mho/m \pm 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 \pm 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 \pm 18.7 % (k=2)



Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$57.3\Omega + 5.18 j\Omega$
Return Loss	- 21.6dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$52.6\Omega + 5.81 j\Omega$
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

Manufactured by	SPEAG
-----------------	-------

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; $\sigma = 1.841$ S/m; $\epsilon_r = 39.63$; $\rho = 1000$ 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)

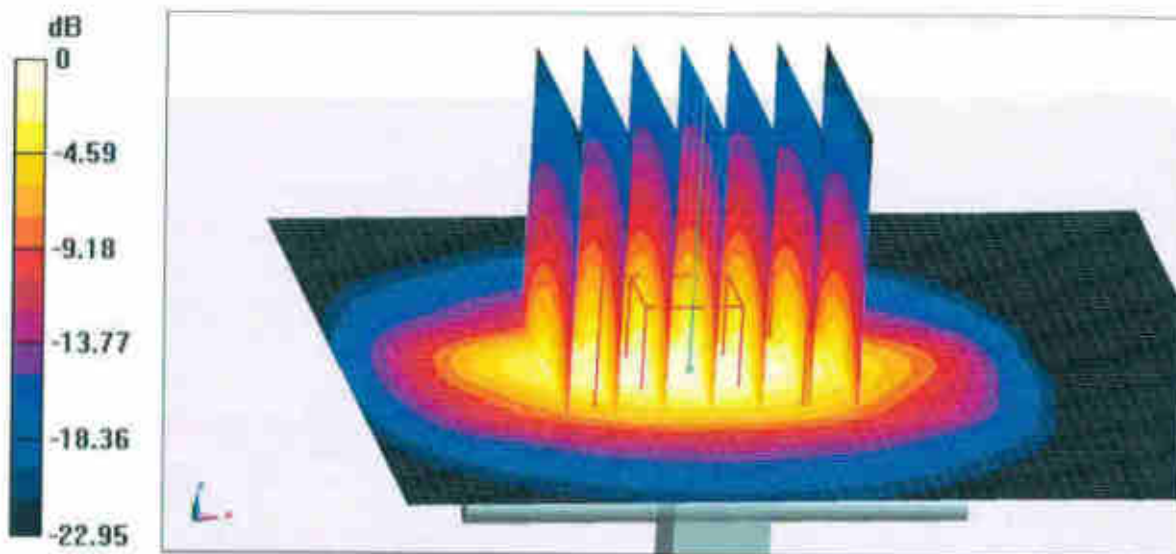
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

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

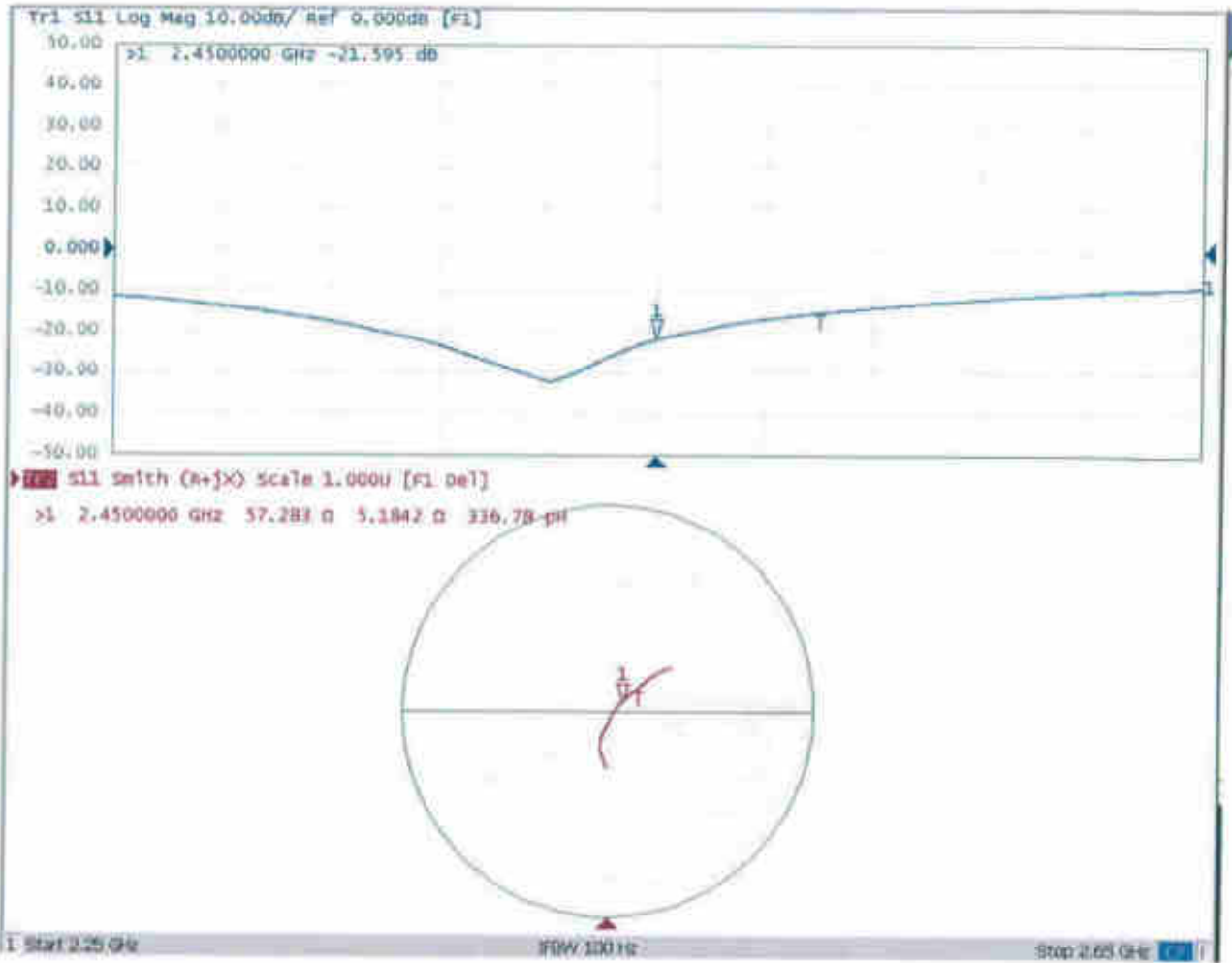


0 dB = 22.4 W/kg = 13.50 dBW/kg



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Impedance Measurement Plot for Head TSL





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DASY5 Validation Report for Body 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; $\sigma = 2.003$ 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)

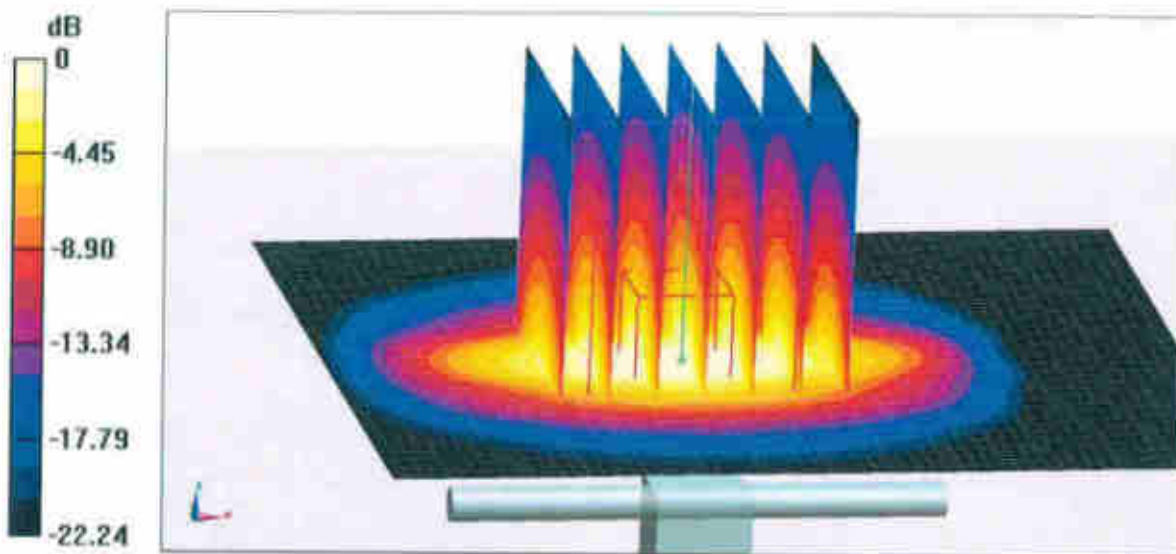
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

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

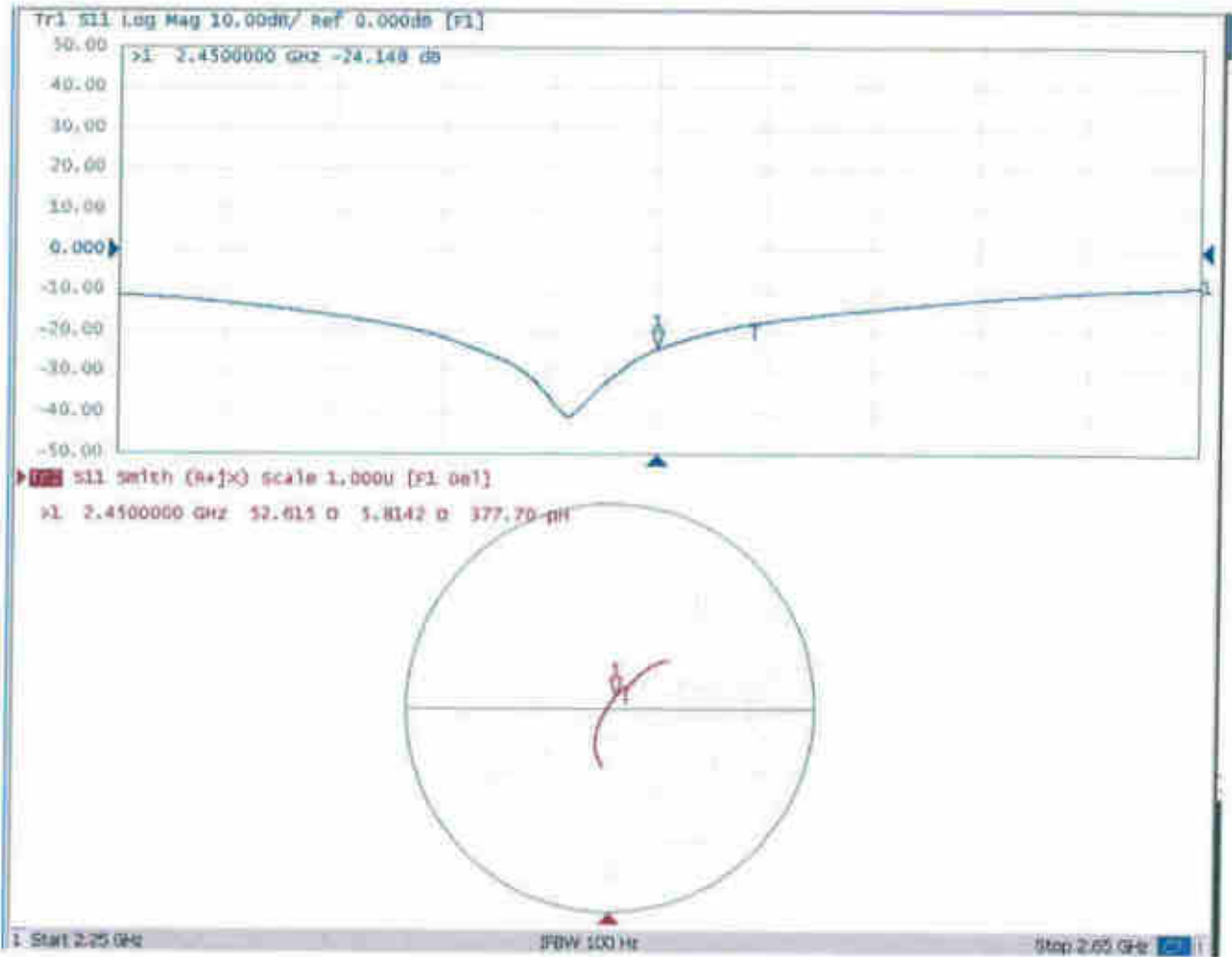


0 dB = 21.4 W/kg = 13.30 dBW/kg



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Impedance Measurement Plot for Body TSL





D2450V2, Serial No. 908 Extended Dipole Calibrations

Referring to KDB 865664 D01 v01r02, if dipoles are verified in return loss ($< -20\text{dB}$, within 20% of prior calibration), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.

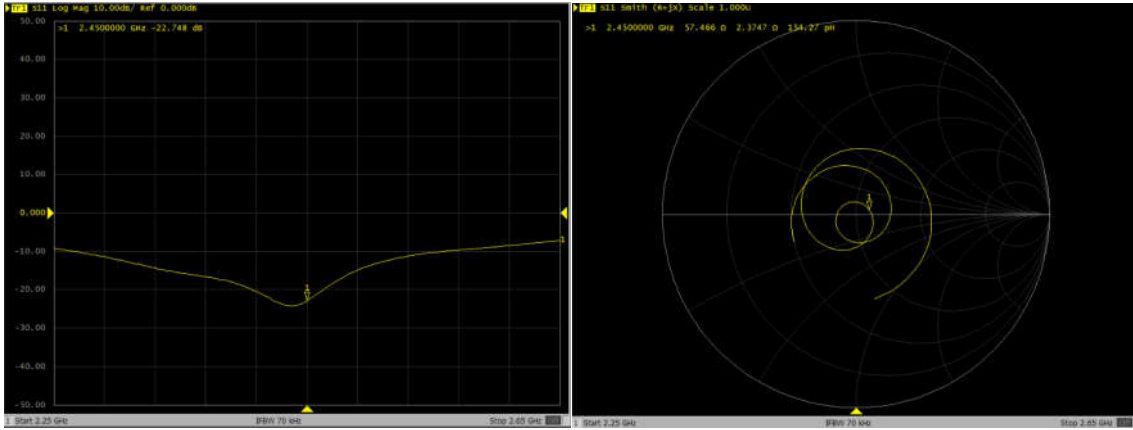
D2450V2 – serial no. 908						
2450 Head						
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2019.3.25	-21.60		57.28		5.18	
2020.3.24	-22.7	-0.05	57.5	-0.18	2.4	2.81
2021.3.24	-21.30	0.01	55.80	1.49	5.67	-0.49

<Justification of the extended calibration>

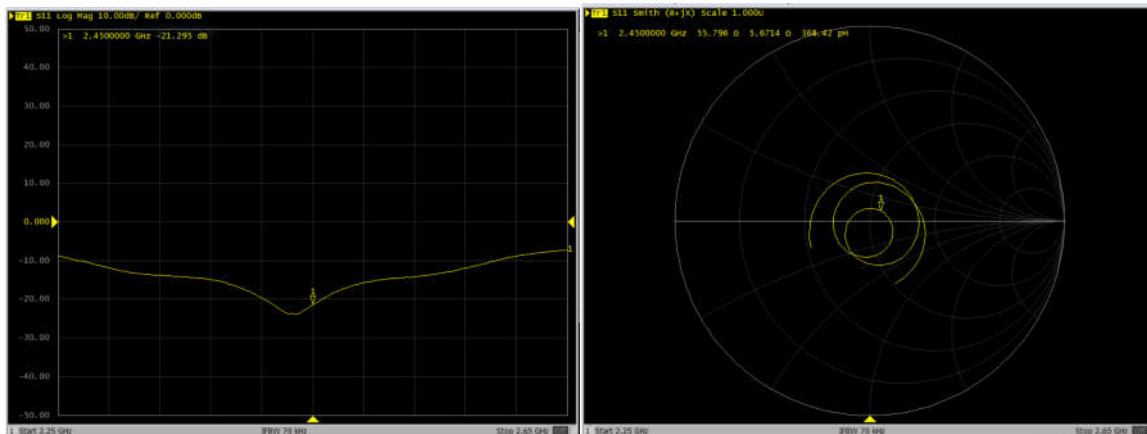
The return loss is $< -20\text{dB}$, within 20% of prior calibration; the impedance is within 5 ohm of prior calibration. Therefore the verification result should support extended calibration.

Dipole Verification Data> D2450V2, serial no. 908

2450MHz – Head----2020.3.24



2450MHz – Head----2021.3.24





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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **Sporton**

Certificate No: **D5GHzV2-1113_Sep19**

CALIBRATION CERTIFICATE

Object **D5GHzV2 - SN:1113**

Calibration procedure(s) **QA CAL-22.v4
Calibration Procedure for SAR Validation Sources between 3-6 GHz**

Calibration date: **September 24, 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 $(22 \pm 3)^{\circ}\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	03-Apr-19 (No. 217-02892/02893)	Apr-20
Power sensor NRP-Z91	SN: 103244	03-Apr-19 (No. 217-02892)	Apr-20
Power sensor NRP-Z91	SN: 103245	03-Apr-19 (No. 217-02893)	Apr-20
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-19 (No. 217-02894)	Apr-20
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-19 (No. 217-02895)	Apr-20
Reference Probe EX3DV4	SN: 3503	25-Mar-19 (No. EX3-3503_Mar19)	Mar-20
DAE4	SN: 601	30-Apr-19 (No. DAE4-601_Apr19)	Apr-20

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Feb-19)	In house check: Oct-20
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-18)	In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19

Calibrated by:	Name Jeton Kastrati	Function Laboratory Technician	Signature
Approved by:	Name Katja Pokovic	Function Technical Manager	Signature

Issued: September 25, 2019

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



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Glossary:

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

Calibration is Performed According to the Following Standards:

- 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
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- 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
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- 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%.

Measurement Conditions

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

DASY Version	DASY5	V52.10.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5250 MHz ± 1 MHz 5600 MHz ± 1 MHz 5750 MHz ± 1 MHz	

Head TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.71 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.1 ± 6 %	4.53 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	---	---

SAR result with Head TSL at 5250 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.09 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	80.5 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.33 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.1 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.6 ± 6 %	4.88 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	---	---

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	83.4 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.8 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.4	5.22 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.4 ± 6 %	5.03 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5750 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.06 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	80.0 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.30 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.8 W/kg ± 19.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	51.7 Ω - 6.2 $j\Omega$
Return Loss	- 24.0 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	56.0 Ω - 2.7 $j\Omega$
Return Loss	- 24.1 dB

Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	56.7 Ω - 1.0 $j\Omega$
Return Loss	- 23.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.195 ns
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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

Manufactured by	SPEAG
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