TEST REPORT

No. 24B01N000863-001-SAR

For

GoPro, Inc.

Camera

Model Name: CPSS1

With

Hardware Version: 335-32185-000:4

Software Version: H24.01.01.09.10

FCC ID: CNFCPSS1

Issued Date: 2024-06-19

Designation Number: CN1210

Note:

The test results in this test report relate only to the devices specified in this report. This report shall not be reproduced except in full without the written approval of SAICT.

Test Laboratory:

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REPORT HISTORY

Report Number	Revision	Description	Issue Date
24B01N000863-001-SAR	Rev.0	1st edition	2024-06-19

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1. Summary of Test Report

1.1. Test Items

Description:	Camera
Model Name:	CPSS1
Applicant's Name:	GoPro, Inc.
Manufacturer's Name:	GoPro, Inc.

1.2. Test Standards

ANSI C95.1:1992, IEEE 1528:2013

1.3. Test Result

Pass. Please refer to "12. Summary of Test Results"

1.4. Testing Location

Address: Building G, Shenzhen International Innovation Center, No.1006 Shennan Road, Futian District, Shenzhen, Guangdong, P. R. China

1.5. Project Data

Testing Start Date: 2024-05-15 Testing End Date: 2024-06-05

1.6. Signature

Li Yongfu
(Prepared this test report)

Liu Jian
(Reviewed this test report)

Cao Junfei
(Approved this test report)

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2. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for GoPro, Inc. Camera CPSS1 are as follows:

Table 2.1: Highest Reported SAR

Equipment Class	Frequency Bands	Head/Body 1g SAR (W/kg) (Separation 10mm)	Extremity 10g SAR (W/kg) (Separation 0mm)
DSS	Bluetooth	0.05	/
DTS	WLAN 2.4GHz	0.38	/
NII	WLAN 5GHz	**1.54**	**1.82**

This device is in compliance with Specific Absorption Rate (SAR) for general population/ uncontrolled exposure limits (1.6 W/kg for Head/Body 1g SAR, 4.0 W/kg for Extremity 10g SAR) specified in ANSI C95.1:1992.

The measurement together with the test system set-up is described in annex C of this test report. A detailed description of the equipment under test can be found in chapter 4 of this test report.

The highest reported SAR value is obtained at the case of **(Table 2.1)**, Head/Body value is **1.54 W/kg (1g)** and Extremity value is **1.82 W/kg (10g)**.

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3. Client Information

3.1. Applicant Information

Company Name:	GoPro, Inc.
Address:	3025 Clearview Way, San Mateo, CA 94402, USA
City:	San Mateo
Country:	USA
Telephone:	/

3.2. Manufacturer Information

Company Name:	GoPro, Inc.
Address:	3025 Clearview Way, San Mateo, CA 94402, USA
City:	San Mateo
Country:	USA
Telephone:	/

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4. Equipment under Test (EUT) and Ancillary Equipment (AE)

4.1. About EUT

Description:	Camera
Model Name:	CPSS1
Condition of EUT as received:	No obvious damage in appearance
Frequency Bands:	Bluetooth, WLAN 2.4GHz/5GHz
Tested Tx Frequency:	2402 – 2480MHz (Bluetooth)
	2412 – 2462MHz (WLAN 2.4GHz)
	5150 – 5850MHz (WLAN 5GHz)
Test device Production information:	Production unit
Device type:	Portable device
Antenna type:	Integrated antenna
Product Dimensions:	Long 71.0mm; Wide 50.0mm; Height 34.0mm

4.2. Internal Identification of EUT used during the test

EUT ID*	IMEI	HW Version	SW Version	Receipt Date
UT01aa	/	335-32185-000:4	H24.01.01.09.10	2024-04-10

*EUT ID: is used to identify the test sample in the lab internally.

4.3. Internal Identification of AE used during the test

AE ID*	Description	Model	Manufacturer
AE1	Battery	CPSS1B	Shenzhen Highpower Technology Co., Ltd.
AE2	Battery	CPSS1B	Dongguan NVT Technology Co., Ltd

*AE ID: is used to identify the test sample in the lab internally.

Note: The device has two types of batteries. We perform the SAR measurement with AE1 battery and Spot check test with AE2 battery.

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5. Test Methodology

5.1. Applicable Limit Regulations

ANSI C95.1:1992 IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.

It specifies the maximum exposure limit of **1.6 W/kg** as averaged over any 1 gram of tissue for portable devices being used within 20 cm of the user in the uncontrolled environment.

5.2. Applicable Measurement Standards

IEEE 1528:2013 Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Experimental Techniques.

KDB 447498 D01 General RF Exposure Guidance v06 RF Exposure Procedures and Equipment Authorization Policies for Mobile and Portable Devices

KDB 248227 D01 802.11 Wi-Fi SAR v02r02 SAR Guidance for IEEE 802.11 (Wi-Fi) Transmitters.

KDB 865664 D01SAR measurement 100 MHz to 6 GHz v01r04 SAR Measurement Requirements for 100 MHz to 6 GHz

KDB 865664 D02 RF Exposure Reporting v01r02 RF Exposure Compliance Reporting and Documentation Considerations

TCB workshop April 2019; RF Exposure Procedures (Tissue Simulating Liquids)

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6. Specific Absorption Rate (SAR)

6.1. Introduction

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

6.2. SAR Definition

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

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

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

SAR measurement can be either related to the temperature elevation in tissue by

$$SAR = c\left(\frac{\delta T}{\delta t}\right)$$

Where: C is the specific head capacity, δT is the temperature rise and δt is the exposure duration, or related to the electrical field in the tissue by

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

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

However for evaluating SAR of low power transmitter, electrical field measurement is typically applied.

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7. Tissue Simulating Liquids

7.1. Targets for tissue simulating liquid

Table 7.1: Targets for tissue simulating liquid

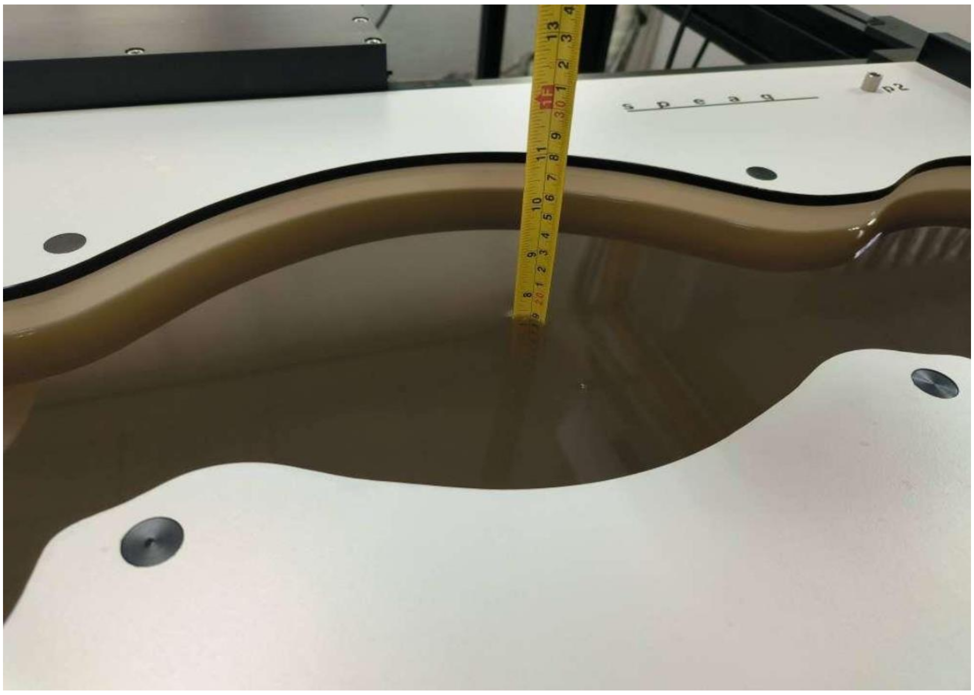
Frequency (MHz)	Liquid Type	Conductivity (σ)	± 5% Range	Permittivity (ε)	± 5% Range
2450	Head	1.80	1.71～1.89	39.2	37.2～41.2
5250	Head	4.71	4.47～4.95	35.9	34.1～37.7
5600	Head	5.07	4.82～5.32	35.5	33.8～37.3
5750	Head	5.22	4.96～5.48	35.4	33.6～37.1

7.2. Dielectric Performance

Table 7.2: Dielectric Performance of Tissue Simulating Liquid

Measurement Date (yyyy-mm-dd)	Frequency (MHz)	Type	Conductivity σ (S/m)	Drift (%)	Permittivity ε	Drift (%)
2024-05-16	2450	Head	1.833	1.83	38.45	-1.91
2024-05-15	5250	Head	4.636	-1.57	36.42	1.45
2024-06-05	5600	Head	4.952	-2.33	36.18	1.92
2024-05-15	5750	Head	5.313	1.78	34.69	-2.01

Note: The liquid temperature is 22.0°C.



Picture 7.2 Liquid depth in the Flat Phantom (0.7GHz - 6.5GHz)

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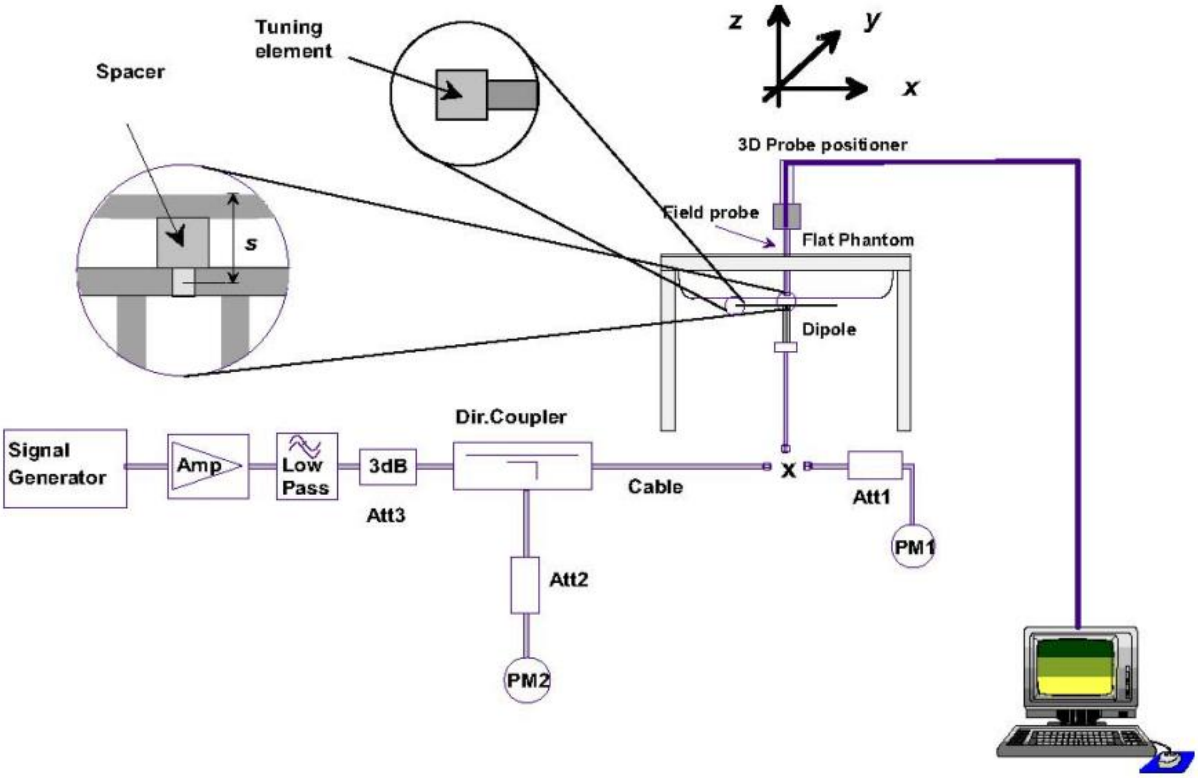
8. System Verification

8.1. System Setup

In the simplified setup for system evaluation, the DUT is replaced by a calibrated dipole and the power source is replaced by a continuous wave that comes from a signal generator. The calibrated dipole must be placed beneath the flat phantom section of the SAM twin phantom with the correct distance holder. The distance holder should touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom. The equipment setup is shown below:



Picture 8.1 System Setup for System Evaluation

For the dipole below 3GHz, the output power on dipole port must be calibrated to 24 dBm (250mW) before dipole is connected.
For the dipole above 3GHz, the output power on dipole port must be calibrated to 20 dBm (100mW) before dipole is connected.

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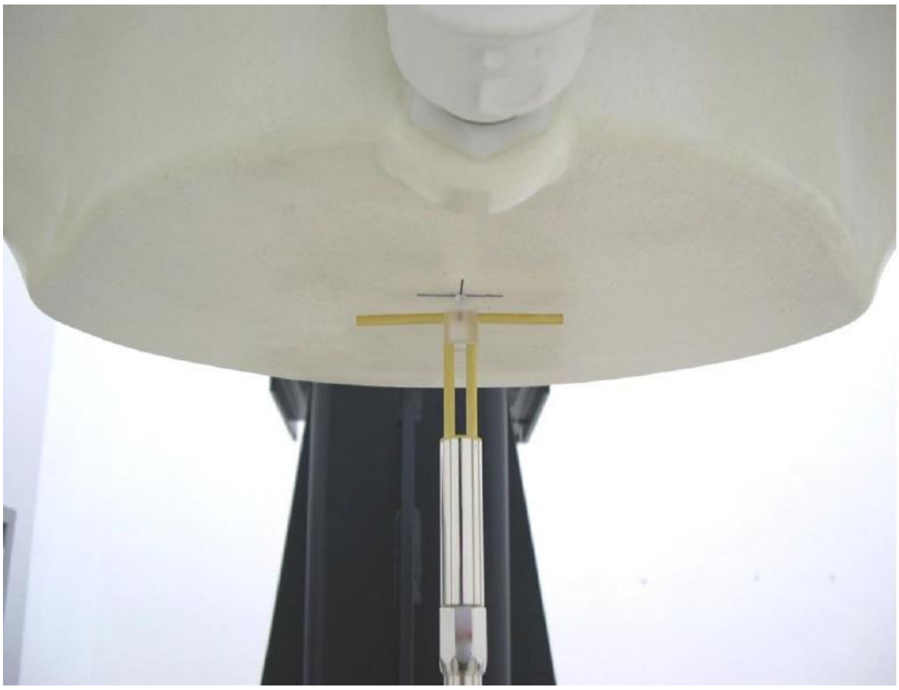

Picture 8.2 Photo of Dipole Setup

8.2. System Verification

SAR system verification is required to confirm measurement accuracy, according to the tissue dielectric media, probe calibration points and other system operating parameters required for measuring the SAR of a test device. The system verification must be performed for each frequency band and within the valid range of each probe calibration point required for testing the device.

Table 9.1: System Verification of Head

Measurement Date	Frequency (MHz)	Target value (W/kg)		Measured value (W/kg)				Deviation (%)	
				/		Normalize to 1W			
		1 g	10 g	1 g	10 g	1 g	10 g	1 g	10 g
2024-05-16	2450	53.20	24.20	13.8	6.16	55.20	24.64	3.76	1.82
2024-05-15	5250	79.70	22.80	7.70	2.24	77.00	22.40	-3.39	-1.75
2024-06-05	5600	82.60	23.60	7.95	2.31	79.50	23.10	-3.75	-2.12
2024-05-15	5750	78.50	22.10	8.07	2.25	80.70	22.50	2.80	1.81

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9. Measurement Procedures

9.1. Tests to be performed

In order to determine the highest value of the peak spatial-average SAR of a handset, all device positions, configurations and operational modes shall be tested for each frequency band according to steps 1 to 3 below. A flowchart of the test process is shown in picture 9.1.

Step 1: The tests described in 9.2 shall be performed at the channel that is closest to the center of the transmit frequency band (f_c) for:

a) all device positions (cheek and tilt, for both left and right sides of the SAM phantom, as described in annex D),
b) all configurations for each device position in a), e.g., antenna extended and retracted, and
c) all operational modes, e.g., analogue and digital, for each device position in a) and configuration in b) in each frequency band.

If more than three frequencies need to be tested according to 11.1 (i.e., $N_c > 3$), then all frequencies, configurations and modes shall be tested for all of the above test conditions.

Step 2: For the condition providing highest peak spatial-average SAR determined in Step 1, perform all tests described in 9.2 at all other test frequencies, i.e., lowest and highest frequencies. In addition, for all other conditions (device position, configuration and operational mode) where the peak spatial-average SAR value determined in Step 1 is within 3 dB of the applicable SAR limit, it is recommended that all other test frequencies shall be tested as well.

Step 3: Examine all data to determine the highest value of the peak spatial-average SAR found in Steps 1 to 2.

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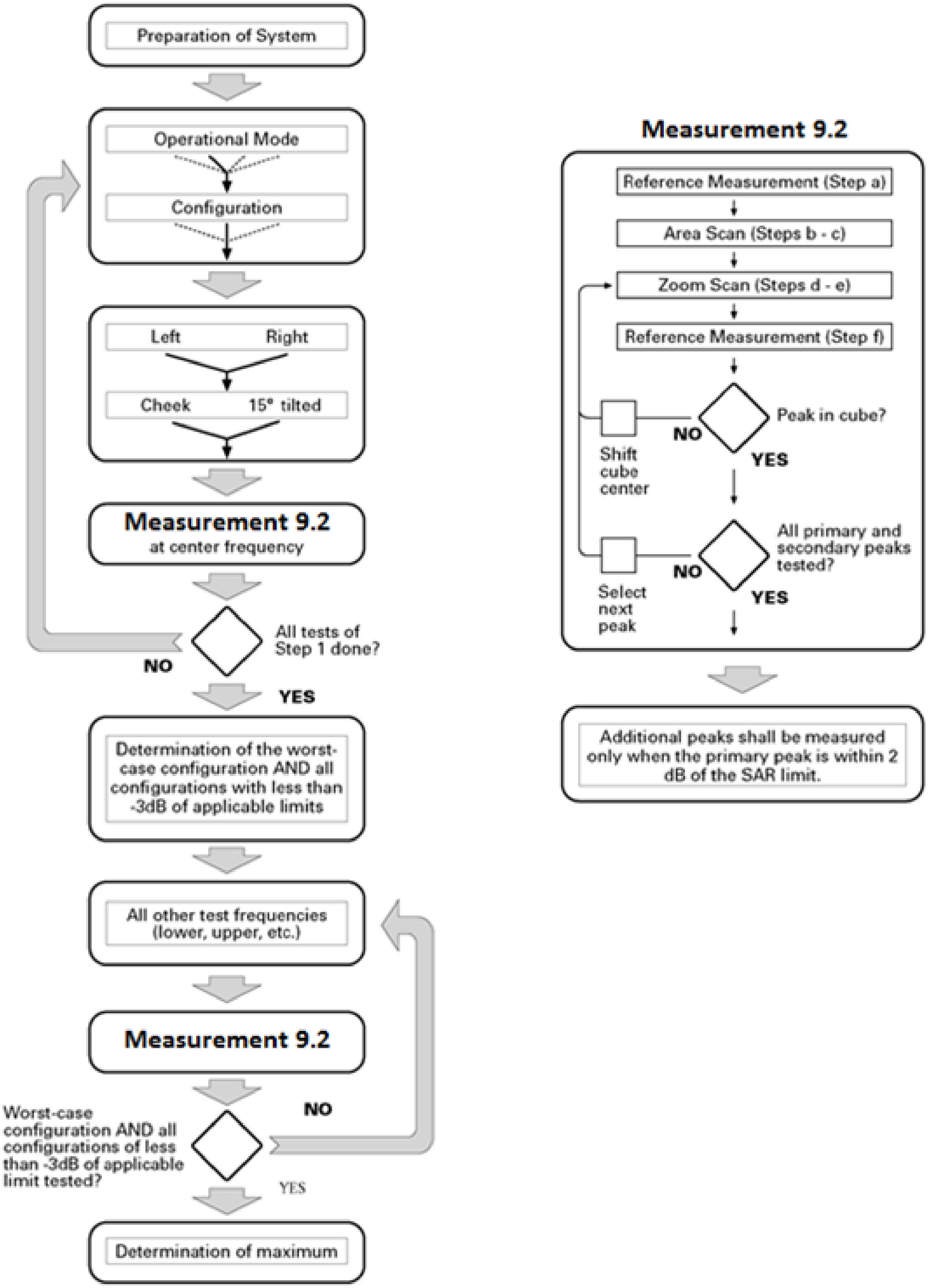

Picture 9.1 Block diagram of the tests to be performed

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9.2. General Measurement Procedure

The area and zoom scan resolutions specified in the table below must be applied to the SAR measurements and fully documented in SAR reports to qualify for TCB approval. Probe boundary effect error compensation is required for measurements with the probe tip closer than half a probe tip diameter to the phantom surface. Both the probe tip diameter and sensor offset distance must satisfy measurement protocols; to ensure probe boundary effect errors are minimized and the higher fields closest to the phantom surface can be correctly measured and extrapolated to the phantom surface for computing 1-g SAR. Tolerances of the post-processing algorithms must be verified by the test laboratory for the scan resolutions used in the SAR measurements, according to the reference distribution functions specified in IEEE Std 1528-2013. The results should be documented as part of the system validation records and may be requested to support test results when all the measurement parameters in the following table are not satisfied.

<table>
<tr><td colspan="3"></td><td>≤ 3 GHz</td><td>> 3 GHz</td></tr>
<tr><td colspan="3">Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5 ± 1 mm</td><td>½·δ·ln(2) ± 0.5 mm</td></tr>
<tr><td colspan="3">Maximum probe angle from probe axis to phantom surface normal at the measurement location</td><td>30° ± 1°</td><td>20° ± 1°</td></tr>
<tr><td colspan="3" rowspan="2">Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}</td><td>≤ 2 GHz: ≤ 15 mm
2 – 3 GHz: ≤ 12 mm</td><td>3 – 4 GHz: ≤ 12 mm
4 – 6 GHz: ≤ 10 mm</td></tr>
<tr><td colspan="2">When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.</td></tr>
<tr><td colspan="3">Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}</td><td>≤ 2 GHz: ≤ 8 mm
2 – 3 GHz: ≤ 5 mm*</td><td>3 – 4 GHz: ≤ 5 mm*
4 – 6 GHz: ≤ 4 mm*</td></tr>
<tr><td rowspan="3">Maximum zoom scan spatial resolution, normal to phantom surface</td><td colspan="2">uniform grid: $\Delta z_{Zoom}(n)$</td><td>≤ 5 mm</td><td>3 – 4 GHz: ≤ 4 mm
4 – 5 GHz: ≤ 3 mm
5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td rowspan="2">graded grid</td><td>$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface</td><td>≤ 4 mm</td><td>3 – 4 GHz: ≤ 3 mm
4 – 5 GHz: ≤ 2.5 mm
5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td>$\Delta z_{Zoom}(n>1)$: between subsequent points</td><td colspan="2">≤ $1.5 \cdot \Delta z_{Zoom}(n-1)$</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>≥ 30 mm</td><td>3 – 4 GHz: ≥ 28 mm
4 – 5 GHz: ≥ 25 mm
5 – 6 GHz: ≥ 22 mm</td></tr>
<tr><td colspan="5">Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.
* When zoom scan is required and the <u>reported</u> SAR from the area scan based 1-g SAR estimation procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.</td></tr>
</table>

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9.3. Bluetooth & WLAN Measurement Procedures for SAR

Normal network operating configurations are not suitable for measuring the SAR of 802.11 transmitters in general. Unpredictable fluctuations in network traffic and antenna diversity conditions can introduce undesirable variations in SAR results. The SAR for these devices should be measured using chipset based test mode software to ensure that the results are consistent and reliable.

Chipset based test mode software is hardware dependent and generally varies among manufacturers. The device operating parameters established in a test mode for SAR measurements must be identical to those programmed in production units, including output power levels, amplifier gain settings and other RF performance tuning parameters. The test frequencies should correspond to actual channel frequencies defined for domestic use. SAR for devices with switched diversity should be measured with only one antenna transmitting at a time during each SAR measurement, according to a fixed modulation and data rate. The same data pattern should be used for all measurements.

9.4. Power Drift

To control the output power stability during the SAR test, DASY5 system calculates the power drift by measuring the E-field at the same location at the beginning and at the end of the measurement for each test position. These drift values can be found in Section 14 labeled as: (Power Drift [dB]). This ensures that the power drift during one measurement is within 5%.

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10. Conducted Output Power

Table 10.1: The conducted power measurement results for Bluetooth

Averaged Power (dBm)				
Mode	Tune up	Ch.0 (2402MHz)	Ch.39 (2441MHz)	Ch.78 (2480MHz)
GFSK	7.0	6.65	6.69	6.53
EDR2M-4_DQPSK	5.0	3.37	3.66	3.85
EDR3M-8DPSK	5.0	3.84	4.12	4.31
/	/	Ch.0 (2402MHz)	Ch.19 (2440MHz)	Ch.39 (2480MHz)
BLE(1M)	7.0	6.92	6.97	5.90
BLE(2M)	8.0	7.11	**7.25**	6.14

Table 10.2: The conducted Power measurement results for WLAN 2.4GHz

Duty Cycle:100%						
Band	**Mode**	**Freq(MHz)**	**RU#+Index#**	**Power level setting**	**Averaged Power (dBm)**	**Tune-up Power (dBm)**
WLAN 2.4GHz	802.11b	2412	/	17	**17.82**	18.0
		2442	/	17	17.53	18.0
		2462	/	17	16.94	18.0
	802.11g	2412	/	19	18.45	20.0
		2442	/	20	19.10	20.0
		2462	/	18	17.62	18.0
	802.11n HT20	2412	/	18	17.50	18.0
		2442	/	20	19.31	20.0
		2462	/	17	16.73	18.0
	802.11n HT40	2412	/	17	16.42	17.0
		2442	/	19	18.92	19.0
		2462	/	16	15.41	16.0
	802.11ax HE20	2412	26RU0	12	12.42	13.0
			52RU37	15	15.35	16.0
			106RU53	18	18.42	19.0
			242RU61	19	18.83	20.0
		2442	26RU4	12	12.64	13.0
			52RU38	15	15.34	16.0
			106RU53	18	18.47	19.0
			242RU61	20	19.85	20.0
		2462	26RU8	12	12.43	13.0
			52RU40	15	15.11	16.0
			106RU54	18	18.26	19.0
			242RU61	18	18.35	20.0
	802.11ax HE40	2422	26RU0	11	10.42	12.4
			52RU37	15	14.53	16.0
			106RU53	18	18.37	19.0
			242RU61	17	16.84	17.0
			484RU65	16	14.29	16.0
		2442	26RU8	12	12.39	12.4
			52RU40	15	14.98	16.0
			106RU54	17	17.35	19.0
			242RU61	19	19.29	20.0
			484RU65	19	18.89	19.0
		2462	26RU17	12	11.43	12.4
			52RU44	16	15.21	16.0
			106RU56	18	18.42	19.0
			242RU62	17	16.64	17.0
			484RU65	16	15.54	16.0

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Table 10.3: The conducted Power measurement results for WLAN 5GHz

U-NII-1

Band	Mode	Freq(MHz)	RU#+Index#	Power level setting	Averaged Power (dBm)	Tune-up Power (dBm)
WLAN 5GHz Band 1	802.11a	5180	/	18	16.99	**18.0**
	802.11a	5200	/	18	17.13	**18.0**
	802.11a	5240	/	18	16.52	**18.0**
	802.11n HT20	5180	/	18	16.97	**18.0**
	802.11n HT20	5200	/	18	17.09	**18.0**
	802.11n HT20	5240	/	18	16.23	**18.0**
	802.11n HT40	5190	/	15	13.30	**14.0**
	802.11n HT40	5230	/	18	16.52	**17.0**
	802.11ac VHT20	5180	/	18	16.92	**17.0**
	802.11ac VHT20	5200	/	18	16.98	**17.0**
	802.11ac VHT20	5240	/	18	16.34	**17.0**
	802.11ac VHT40	5190	/	14	12.40	**13.0**
	802.11ac VHT40	5230	/	18	16.43	**17.0**
	802.11ac VHT80	5210	/	14	11.54	**12.0**
	802.11ax HE20	5180	26RU0	8	9.12	**11.0**
			52RU37	11	11.68	**13.0**
			106RU53	15	15.41	**17.0**
			242RU61	17	17.01	**18.0**
		5200	26RU4	9	10.11	**11.0**
			52RU38	12	12.52	**13.0**
			106RU53	16	16.21	**17.0**
			242RU61	17	16.81	**18.0**
		5240	26RU8	8	9.21	**11.0**
			52RU40	11	11.53	**13.0**
			106RU54	15	15.43	**17.0**
			242RU61	17	16.33	**18.0**
	802.11ax HE40	5190	26RU0	9	9.68	**10.0**
			52RU37	12	12.53	**13.0**
			106RU53	15	15.33	**16.0**
			242RU61	18	**17.88**	**18.0**
			484RU65	14	14.04	**15.0**
		5230	26RU17	9	9.72	**11.0**
			52RU44	12	12.45	**13.0**
			106RU56	15	15.39	**16.0**
			242RU62	18	17.35	**18.0**
			484RU65	16	15.84	**16.0**
	802.11ax HE80	5210	26RU0	10	10.23	**11.0**
			52RU37	12	12.11	**13.0**
			106RU53	15	15.23	**16.0**
			242RU61	18	16.65	**17.0**
			484RU65	14	14.34	**15.0**
			996RU67	14	14.45	**15.0**

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U-NII-2A

Duty Cycle:100%						
Band	**Mode**	**Freq(MHz)**	**RU#+Index#**	**Power level setting**	**Averaged Power (dBm)**	**Tune-up Power (dBm)**
WLAN 5GHz Band 2	802.11a	5260	/	15	14.92	**16.0**
	802.11a	5280	/	15	14.94	**16.0**
	802.11a	5320	/	15	15.21	**16.0**
	802.11n HT20	5260	/	18	**16.88**	**18.0**
	802.11n HT20	5280	/	18	16.65	**18.0**
	802.11n HT20	5320	/	18	16.43	**18.0**
	802.11n HT40	5270	/	18	16.52	**17.0**
	802.11n HT40	5310	/	16	15.05	**17.0**
	802.11ac VHT20	5260	/	18	16.64	**17.0**
	802.11ac VHT20	5280	/	18	16.43	**17.0**
	802.11ac VHT20	5320	/	18	16.62	**17.0**
	802.11ac VHT40	5270	/	18	16.52	**17.0**
	802.11ac VHT40	5310	/	15	13.92	**15.0**
	802.11ac VHT80	5290	/	14	12.24	**13.0**
	802.11ax HE20	5260	26RU0	5	6.82	**7.0**
			52RU37	8	9.92	**10.0**
			106RU53	12	12.91	**14.0**
			242RU61	16	16.34	**17.0**
		5280	26RU4	5	6.42	**7.0**
			52RU38	8	9.72	**10.0**
			106RU53	12	12.83	**14.0**
			242RU61	16	16.23	**17.0**
		5320	26RU8	5	6.94	**7.0**
			52RU40	8	9.92	**10.0**
			106RU54	12	13.62	**14.0**
			242RU61	16	16.42	**17.0**
	802.11ax HE40	5270	26RU0	6	7.32	**8.0**
			52RU37	9	10.42	**11.0**
			106RU53	12	12.78	**14.0**
			242RU61	16	15.93	**17.0**
			484RU65	16	15.51	**17.0**
		5310	26RU17	6	7.42	**8.0**
			52RU44	9	10.42	**11.0**
			106RU56	12	13.76	**14.0**
			242RU62	16	16.42	**17.0**
			484RU65	16	16.32	**17.0**
	802.11ax HE80	5290	26RU36	6	7.33	**8.0**
			52RU52	9	9.86	**10.0**
			106RU60	11	12.36	**13.0**
			242RU64	15	15.34	**16.0**
			484RU66	14	14.00	**15.0**
			996RU67	14	14.12	**15.0**

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U-NII-2C

Duty Cycle:100%						
Band	Mode	Freq(MHz)	RU#+Index#	Power level setting	Averaged Power (dBm)	Tune-up Power (dBm)
5G WIFI Band 3	802.11a	5500	/	16	15.83	16.0
	802.11a	5580	/	16	15.63	16.0
	802.11a	5700	/	16	15.72	16.0
	802.11a	5720	/	16	15.81	16.0
	802.11n HT20	5500	/	16	15.64	16.0
	802.11n HT20	5580	/	16	15.58	16.0
	802.11n HT20	5700	/	16	15.68	16.0
	802.11n HT20	5720	/	16	15.65	16.0
	802.11n HT40	5510	/	13	12.83	14.0
	802.11n HT40	5550	/	14	15.19	16.0
	802.11n HT40	5670	/	14	15.58	16.0
	802.11n HT40	5710	/	14	15.52	16.0
	802.11ac VHT20	5500	/	16	15.41	16.0
	802.11ac VHT20	5580	/	16	15.52	16.0
	802.11ac VHT20	5700	/	16	15.72	16.0
	802.11ac VHT20	5720	/	16	15.78	16.0
	802.11ac VHT40	5510	/	13	12.74	14.0
	802.11ac VHT40	5550	/	14	15.07	16.0
	802.11ac VHT40	5670	/	14	15.57	16.0
	802.11ac VHT40	5710	/	14	15.49	16.0
	802.11ac VHT80	5530	/	12	11.45	12.0
	802.11ac VHT80	5610		13	14.56	15.0
	802.11ac VHT80	5690	/	13	14.19	15.0
	802.11ax HE20	5500	26RU0	5	6.32	7.0
			52RU37	7	8.72	10.0
			106RU53	10	11.83	12.0
			242RU61	14	14.35	16.0
		5580	26RU4	5	6.32	7.0
			52RU38	7	8.41	10.0
			106RU53	10	11.78	12.0
			242RU61	14	14.41	16.0
		5700	26RU8	3	5.42	7.0
			52RU40	7	9.02	10.0
			106RU54	10	11.99	12.0
			242RU61	14	15.82	16.0
		5720	26RU8	3	5.53	7.0
			52RU40	7	9.13	10.0
			106RU54	10	11.98	12.0
			242RU61	14	15.87	16.0
	802.11ax HE40	5510	26RU0	5	5.82	6.0
			52RU37	8	9.13	10.0
			106RU53	11	12.03	13.0
			242RU61	14	14.42	16.0
			484RU65	13	13.02	15.01
		5550	26RU8	5	5.82	6.0
			52RU40	8	9.12	10.0
			106RU54	11	11.32	13.0
			242RU61	15	15.37	16.0
			484RU65	15	14.24	15.01
		5670	26RU17	5	5.63	6.0
			52RU44	7	8.46	10.0
			106RU56	10	11.79	13.0
			242RU62	15	15.43	16.0
			484RU65	15	15.01	15.01
		5710	26RU17	5	5.72	6.0
			52RU44	7	8.51	10.0
			106RU56	10	11.83	13.0
			242RU62	15	15.41	16.0
			484RU65	15	15.00	15.01
	802.11ax HE80	5530	26RU0	5	5.34	6.0
			52RU37	8	8.34	10.0
			106RU53	13	12.56	13.0
			242RU61	15	14.93	16.0
			484RU65	13	12.87	13.0
			996RU67	10	9.83	10.0
		5610	26RU36	5	6.02	7.0
			52RU52	8	9.33	10.0
			106RU60	11	12.01	13.0
			242RU64	15	**15.21**	16.0
			484RU66	15	14.68	15.0
			996RU67	15	14.32	15.0
		5690	26RU36	5	6.01	7.0
			52RU52	8	9.34	10.0
			106RU60	11	12.10	13.0
			242RU64	15	15.19	16.0
			484RU66	15	14.68	15.0
			996RU67	15	14.34	15.0

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U-NII-3

Duty Cycle:100%						
Band	**Mode**	**Freq(MHz)**	**RU#+Index#**	**Power level setting**	**Averaged Power (dBm)**	**Tune-up Power (dBm)**
WLAN 5GHz Band 4	802.11a	5745	/	10	9.54	**11.0**
	802.11a	5785	/	10	9.61	**11.0**
	802.11a	5825	/	10	9.74	**11.0**
	802.11n HT20	5745	/	10	9.63	**11.0**
	802.11n HT20	5785	/	10	9.31	**11.0**
	802.11n HT20	5825	/	10	9.40	**11.0**
	802.11n HT40	5755	/	10	9.88	**11.0**
	802.11n HT40	5795	/	10	9.45	**11.0**
	802.11ac VHT20	5745	/	10	9.63	**11.0**
	802.11ac VHT20	5785	/	10	9.32	**11.0**
	802.11ac VHT20	5825	/	10	9.41	**11.0**
	802.11ac VHT40	5755	/	10	9.87	**11.0**
	802.11ac VHT40	5795	/	10	9.42	**11.0**
	802.11ac VHT80	5775	/	11	10.56	**11.0**
	802.11ax HE20	5745	26RU0	9	9.52	**11.0**
			52RU37	9	9.62	**11.0**
			106RU53	9	9.55	**11.0**
			242RU61	10	10.32	**11.0**
		5785	26RU4	9	9.42	**11.0**
			52RU38	9	9.33	**11.0**
			106RU53	9	9.34	**11.0**
			242RU61	10	9.89	**11.0**
		5825	26RU8	9	9.32	**11.0**
			52RU40	9	9.53	**11.0**
			106RU54	9	9.32	**11.0**
			242RU61	10	9.88	**11.0**
	802.11ax HE40	5755	26RU0	10	9.72	**11.0**
			52RU37	10	9.69	**11.0**
			106RU53	10	9.87	**11.0**
			242RU61	10	9.98	**11.0**
			484RU65	10	9.92	**11.0**
		5795	26RU17	10	9.21	**11.0**
			52RU44	10	9.45	**11.0**
			106RU56	10	9.67	**11.0**
			242RU62	10	9.52	**11.0**
			484RU65	10	9.51	**11.0**
	802.11ax HE80	5775	26RU0	11	9.62	**11.0**
			52RU37	11	9.87	**11.0**
			106RU53	11	9.82	**11.0**
			242RU61	11	10.21	**11.0**
			484RU65	11	**10.61**	**11.0**
			996RU67	11	10.43	**11.0**

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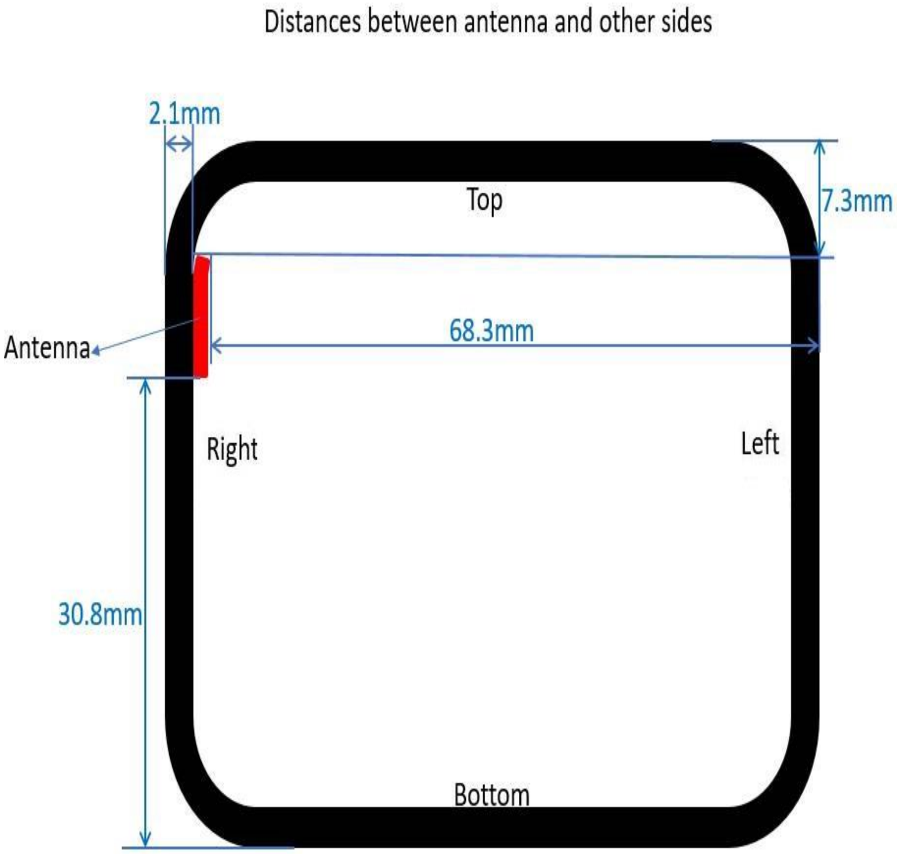
11. Transmit Antenna Position and Size



Picture 11.1 Antenna Locations (Back View)

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12. Summary of Test Results

According to the client's decision rule in the test registration form, which is "based on the measurement results as the basis of the conformity statement", the test conclusion of this report meets the limit requirements.

The calculated SAR is obtained by the following formula:

$$\text{Calculated SAR} = \text{Measured SAR} \times 10^{(P_{\text{Target}} - P_{\text{Measured}})/10}$$

Where P_{Target} is the power of manufacturing upper limit;

$P_{Measured}$ is the measured power in chapter 10.

Note: B2 (Battery): CPSS1B (Dongguan NVT Technology Co.,Ltd)

Duty Cycle

Mode	**Duty Cycle**
Bluetooth	1:1
WLAN	1:1

12.1. Testing Environment

Temperature:	18°C~25°C
Relative humidity:	30%~70%
Ambient noise & Reflection:	< 0.012 W/kg

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12.2. Test Results

Table 12.1: Bluetooth SAR Values

RF Exposure Conditions	Frequency Band	Channel Number	Frequency (MHz)	Mode/RB	Test Position	Distance	Note	Figure No.	EUT Measured Power (dBm)	Tune up (dBm)	Measured SAR 1g (W/kg)	Calculated SAR 1g (W/kg)	Measured SAR 10g (W/kg)	Calculated SAR 10g (W/kg)	Power Drift
Head/Body	Bluetooth	19	2440.0	BLE 2M	Front	10mm	\	\	7.25	8.00	0.009	**0.01**	0.005	**0.01**	0.03
Head/Body	Bluetooth	19	2440.0	BLE 2M	Rear	10mm	\	\	7.25	8.00	0.016	**0.02**	0.009	**0.01**	0.09
Head/Body	Bluetooth	19	2440.0	BLE 2M	Left	10mm	\	\	7.25	8.00	0.006	**0.01**	0.004	**<0.01**	0.08
Head/Body	Bluetooth	19	2440.0	BLE 2M	Right	10mm	\	\	7.25	8.00	0.008	**0.01**	0.004	**<0.01**	0.07
Head/Body	Bluetooth	19	2440.0	BLE 2M	Top	10mm	\	**1**	7.25	8.00	**0.041**	**0.05**	0.021	**0.03**	0.16
Head/Body	Bluetooth	19	2440.0	BLE 2M	Bottom	10mm	\	\	7.25	8.00	0.003	**<0.01**	0.001	**<0.01**	0.04

Table 12.2: WLAN 2.4GHz SAR Values

RF Exposure Conditions	Frequency Band	Channel Number	Frequency (MHz)	Mode/RB	Test Position	Distance	Note	Figure No.	EUT Measured Power (dBm)	Tune up (dBm)	Measured SAR 1g (W/kg)	Calculated SAR 1g (W/kg)	Measured SAR 10g (W/kg)	Calculated SAR 10g (W/kg)	Power Drift
Head/Body	WLAN 2.4GHz	1	2412.0	802.11b	Front	10mm	\	\	17.82	18.00	0.165	**0.17**	0.096	**0.10**	0.07
Head/Body	WLAN 2.4GHz	1	2412.0	802.11b	Rear	10mm	\	\	17.82	18.00	0.137	**0.14**	0.079	**0.08**	-0.09
Head/Body	WLAN 2.4GHz	1	2412.0	802.11b	Left	10mm	\	\	17.82	18.00	0.079	**0.08**	0.045	**0.05**	-0.05
Head/Body	WLAN 2.4GHz	1	2412.0	802.11b	Right	10mm	\	\	17.82	18.00	0.068	**0.07**	0.037	**0.04**	0.15
Head/Body	WLAN 2.4GHz	1	2412.0	802.11b	Top	10mm	\	**2**	17.82	18.00	**0.365**	**0.38**	0.194	**0.20**	-0.09
Head/Body	WLAN 2.4GHz	1	2412.0	802.11b	Bottom	10mm	\	\	17.82	18.00	0.030	**0.03**	0.017	**0.02**	-0.08

Note:

1. According to the KDB 248227 D01, SAR is measured for 2.4GHz 802.11b DSSS using the initial test position procedure.

2. For all positions/configurations tested using the initial test position and subsequent test positions, 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 until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.

3. SAR is not required for OFDM because the 802.11b adjusted SAR ≤ 1.2 W/kg.

4. According to the KDB 248227 D01, the reported SAR must be scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit.

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Table 12.3: WLAN 5GHz SAR Values

RF Exposure Conditions	Frequency Band	Channel Number	Frequency (MHz)	Mode/RB	Test Position	Distance	Note	Figure No.	EUT Measured Power (dBm)	Tune up (dBm)	Measured SAR 1g (W/kg)	Calculated SAR 1g (W/kg)	Measured SAR 10g (W/kg)	Calculated SAR 10g (W/kg)	Power Drift
Head/Body	U-NII-1	38	5190.0	802.11ax (40M)	Front	10mm	\	\	17.88	18.00	0.281	0.29	0.116	0.12	0.06
Head/Body	U-NII-1	38	5190.0	802.11ax (40M)	Rear	10mm	\	\	17.88	18.00	0.228	0.23	0.087	0.09	0.12
Head/Body	U-NII-1	38	5190.0	802.11ax (40M)	Left	10mm	\	\	17.88	18.00	0.075	0.08	0.033	0.03	0.17
Head/Body	U-NII-1	38	5190.0	802.11ax (40M)	Right	10mm	\	\	17.88	18.00	0.330	0.34	0.135	0.14	0.06
Head/Body	U-NII-1	38	5190.0	802.11ax (40M)	Top	10mm	\	\	17.88	18.00	0.719	0.74	0.225	0.23	0.03
Head/Body	U-NII-1	38	5190.0	802.11ax (40M)	Bottom	10mm	\	\	17.88	18.00	0.074	0.08	0.031	0.03	0.09
Head/Body	U-NII-2A	52	5260.0	802.11n(20M)	Front	10mm	\	\	16.88	18.00	0.260	0.34	0.104	0.13	-0.01
Head/Body	U-NII-2A	52	5260.0	802.11n(20M)	Rear	10mm	\	\	16.88	18.00	0.200	0.26	0.069	0.09	0.05
Head/Body	U-NII-2A	52	5260.0	802.11n(20M)	Left	10mm	\	\	16.88	18.00	0.059	0.08	0.025	0.03	0.08
Head/Body	U-NII-2A	52	5260.0	802.11n(20M)	Right	10mm	\	\	16.88	18.00	0.277	0.36	0.114	0.15	0.11
Head/Body	U-NII-2A	52	5260.0	802.11n(20M)	Top	10mm	\	\	16.88	18.00	0.775	1.00	0.230	0.30	-0.19
Head/Body	U-NII-2A	52	5260.0	802.11n(20M)	Bottom	10mm	\	\	16.88	18.00	0.086	0.11	0.029	0.04	0.19
Head/Body	U-NII-2A	56	5280.0	802.11n(20M)	Top	10mm	\	\	16.65	18.00	0.747	1.02	0.244	0.33	-0.09
Head/Body	U-NII-2C	122	5610.0	802.11ax(80M)	Front	10mm	\	\	15.21	16.00	0.182	0.22	0.068	0.08	-0.04
Head/Body	U-NII-2C	122	5610.0	802.11ax(80M)	Rear	10mm	\	\	15.21	16.00	0.336	0.40	0.091	0.11	0.08
Head/Body	U-NII-2C	122	5610.0	802.11ax(80M)	Left	10mm	\	\	15.21	16.00	0.065	0.08	0.017	0.02	-0.19
Head/Body	U-NII-2C	122	5610.0	802.11ax(80M)	Right	10mm	\	\	15.21	16.00	0.298	0.36	0.113	0.14	0.13
Head/Body	U-NII-2C	122	5610.0	802.11ax(80M)	Top	10mm	\	\	15.21	16.00	1.160	1.39	0.356	0.43	-0.08
Head/Body	U-NII-2C	122	5610.0	802.11ax(80M)	Bottom	10mm	\	\	15.21	16.00	0.072	0.09	0.022	0.03	-0.13
Head/Body	U-NII-2C	138	5690.0	802.11ax(80M)	Top	10mm	\	3	15.19	16.00	1.280	1.54	0.409	0.49	-0.09
Head/Body	U-NII-2C	122	5610.0	802.11ax(80M)	Top	10mm	\	\	14.93	16.00	0.598	0.77	0.171	0.22	-0.16
Head/Body	U-NII-2C	138	5690.0	802.11ax(80M)	Top	10mm	B2	\	15.19	16.00	1.220	1.47	0.386	0.47	0.04
Head/Body	U-NII-3	155	5775.0	802.11ac(80M)	Front	10mm	\	\	10.61	11.00	0.078	0.09	0.025	0.03	-0.04
Head/Body	U-NII-3	155	5775.0	802.11ac(80M)	Rear	10mm	\	\	10.61	11.00	0.136	0.15	0.046	0.05	0.18
Head/Body	U-NII-3	155	5775.0	802.11ac(80M)	Left	10mm	\	\	10.61	11.00	0.082	0.09	0.024	0.03	-0.04
Head/Body	U-NII-3	155	5775.0	802.11ac(80M)	Right	10mm	\	\	10.61	11.00	0.127	0.14	0.053	0.06	-0.13
Head/Body	U-NII-3	155	5775.0	802.11ac(80M)	Top	10mm	\	\	10.61	11.00	0.372	0.41	0.120	0.13	-0.14
Head/Body	U-NII-3	155	5775.0	802.11ac(80M)	Bottom	10mm	\	\	10.61	11.00	0.098	0.11	0.020	0.02	-0.08

Note:

1. For all positions/configurations tested using the initial test position and subsequent test positions, 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 until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.

2. According to the KDB 248227 D01, the reported SAR must be scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit.

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12.3. Product specific 10g SAR

Table 12.4: WLAN 5GHz SAR Values

RF Exposure Conditions	Frequency Band	Channel Number	Frequency (MHz)	Mode/RB	Test Position	Distance	Note	Figure No.	EUT Measured Power (dBm)	Tune up (dBm)	Measured SAR 1g (W/kg)	Calculated SAR 1g (W/kg)	Measured SAR 10g (W/kg)	Calculated SAR 10g (W/kg)	Power Drift
Extremity	U-NII-2C	138	5690.0	802.11ax(80M)	Top	0mm	\	**4**	15.19	16.00	6.930	**8.35**	**1.510**	**1.82**	0.07
Extremity	U-NII-2C	138	5690.0	802.11ax(80M)	Top	0mm	B2	\	15.19	16.00	6.770	**8.16**	1.400	**1.69**	0.02

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13. SAR Measurement Variability

SAR measurement variability must be assessed for each frequency band, which is determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media are required for SAR measurements in a frequency band, the variability measurement procedures should be applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium.

The following procedures are applied to determine if repeated measurements are required.

1) Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg; steps 2) through 4) do not apply.

2) When the original highest measured SAR is ≥ 0.80 W/kg, repeat that measurement once.

3) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or when the original or repeated measurement is ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).

4) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

Table 13.1: SAR Measurement Variability

Frequency Band	Frequency		RF Exposure Conditions	Test Position	Original	1st Repeated	Ratio	2nd Repeated
	Ch.	MHz			SAR (W/kg)	SAR (W/kg)		SAR (W/kg)
U-NII-2C	138	5690.0	Head/Body	Top	1.280	1.250	1.02	/

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14. Measurement Uncertainty

14.1. Measurement Uncertainty for Normal SAR Tests (300MHz~3GHz)

No.	Error Description	Type	Uncertainty value	Probably Distribution	Div.	(Ci) 1g	(Ci) 10g	Std. Unc. (1g)	Std. Unc. (10g)	Degree of freedom
Measurement system										
1	Probe calibration	B	12.7	N	2	1	1	6.35	6.35	∞
2	Axial isotropy	B	4.7	R	$\sqrt{3}$	$\sqrt{0.5}$	$\sqrt{0.5}$	4.3	4.3	∞
3	Hemispherical isotropy	B	9.6	R	$\sqrt{3}$	1	1	4.8	4.8	∞
4	Boundary effect	B	1.1	R	$\sqrt{3}$	1	1	0.6	0.6	∞
5	Linearity	B	4.7	R	$\sqrt{3}$	1	1	2.7	2.7	∞
6	Detection limit	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
7	Modulation response	B	4.0	R	$\sqrt{3}$	1	1	2.3	2.3	∞
8	Readout electronics	B	1.0	N	1	1	1	1.0	1.0	∞
9	Response time	B	0.8	R	$\sqrt{3}$	1	1	0.5	0.5	∞
10	Integration time	B	1.7	R	$\sqrt{3}$	1	1	1.0	1.0	∞
11	RF ambient conditions-noise	B	3.0	R	$\sqrt{3}$	1	1	1.7	1.7	∞
12	RF ambient conditions-reflection	B	3.0	R	$\sqrt{3}$	1	1	1.7	1.7	∞
13	Probe positioned mech. restrictions	B	0.35	R	$\sqrt{3}$	1	1	0.2	0.2	∞
14	Probe positioning with respect to phantom shell	B	2.9	R	$\sqrt{3}$	1	1	1.7	1.7	∞
15	Post-processing	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
Test sample related										
16	Test sample positioning	A	3.3	N	1	1	1	3.3	3.3	5
17	Device holder uncertainty	A	3.4	N	1	1	1	3.4	3.4	5
18	Power scaling	B	0	R	$\sqrt{3}$	1	1	0	0	∞
19	Drift of output power	B	5.0	R	$\sqrt{3}$	1	1	2.9	2.9	∞
Phantom and set-up										
20	Phantom uncertainty	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
21	Algorithm for correcting SAR for deviations in permittivity and conductivity	B	1.9	N	1	1	0.84	1.9	1.6	∞
22	Liquid conductivity (target)	B	5.0	R	$\sqrt{3}$	0.64	0.43	1.8	1.2	∞
23	Liquid conductivity (meas.)	A	1.3	N	1	0.64	0.43	0.83	0.56	9
24	Liquid permittivity (target)	B	5.0	R	$\sqrt{3}$	0.6	0.49	1.7	1.4	∞
25	Liquid permittivity (meas.)	A	1.6	N	1	0.6	0.49	0.96	0.78	9
Combined standard uncertainty		$u_c' = \sqrt{\sum_{i=1}^{23} c_i^2 u_i^2}$						11.6	11.4	95.5
Expanded uncertainty (Confidence interval of 95 %)		$u_e = 2u_c$						23.2	22.8	

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14.2. Measurement Uncertainty for Normal SAR Tests (3GHz~6GHz)

No.	Error Description	Type	Uncertainty value	Probably Distribution	Div.	(Ci) 1g	(Ci) 10g	Std. Unc. (1g)	Std. Unc. (10g)	Degree of freedom
Measurement system										
1	Probe calibration	B	13.9	N	2	1	1	6.95	6.95	∞
2	Axial isotropy	B	4.7	R	√3	√0.5	√0.5	4.3	4.3	∞
3	Hemispherical isotropy	B	9.6	R	√3	1	1	4.8	4.8	∞
4	Boundary effect	B	1.1	R	√3	1	1	0.6	0.6	∞
5	Linearity	B	4.7	R	√3	1	1	2.7	2.7	∞
6	Detection limit	B	1.0	R	√3	1	1	0.6	0.6	∞
7	modulation response	B	4.0	R	√3	1	1	2.3	2.3	∞
8	Readout electronics	B	1.0	N	1	1	1	1.0	1.0	∞
9	Response time	B	0.0	R	√3	1	1	0.0	0.0	∞
10	Integration time	B	1.7	R	√3	1	1	1.0	1.0	∞
11	RF ambient conditions-noise	B	3.0	R	√3	1	1	1.7	1.7	∞
12	RF ambient conditions-reflection	B	3.0	R	√3	1	1	1.7	1.7	∞
13	Probe positioned mech. Restrictions	B	0.35	R	√3	1	1	0.2	0.2	∞
14	Probe positioning with respect to phantom shell	B	2.9	R	√3	1	1	1.7	1.7	∞
15	Post-processing	B	1.0	R	√3	1	1	0.6	0.6	∞
Test sample related										
16	Test sample positioning	A	3.3	N	1	1	1	3.3	3.3	5
17	Device holder uncertainty	A	3.4	N	1	1	1	3.4	3.4	5
18	Power scaling	B	0	R	√3	1	1	0	0	∞
19	Drift of output power	B	5.0	R	√3	1	1	2.9	2.9	∞
Phantom and set-up										
20	Phantom uncertainty	B	1.0	R	√3	1	1	0.6	0.6	∞
21	Algorithm for correcting SAR for deviations in permittivity and conductivity	B	1.9	N	1	1	0.84	1.9	1.6	∞
22	Liquid conductivity (target)	B	5.0	R	√3	0.64	0.43	1.8	1.2	∞
23	Liquid conductivity (meas.)	A	1.3	N	1	0.64	0.43	0.83	0.56	9
24	Liquid permittivity (target)	B	5.0	R	√3	0.6	0.49	1.7	1.4	∞
25	Liquid permittivity (meas.)	A	1.6	N	1	0.6	0.49	0.96	0.78	9
Combined standard uncertainty		$u_c' = \sqrt{\sum_{i=1}^{22} c_i^2 u_i^2}$						11.9	11.8	95.5
Expanded uncertainty (Confidence interval of 95 %)		$u_e = 2u_c$						23.8	23.6	

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15. Main Test Instruments

Table 15.1: List of Main Instruments

No.	Name	Type	Serial Number	Calibration Date	Valid Period
01	Network analyzer	E5071C	MY46103759	2023-11-13	One year
02	Dielectric probe	85070E	MY44300317	/	/
03	Power meter	E4418B	MY50000366	2023-12-10	One year
04	Power sensor	E9304A	MY50000188	2023-12-10	One year
05	Power meter	NRP	102603	2023-12-28	One year
06	Power sensor	NRP-Z51	102211	2023-12-28	One year
07	Signal Generator	E8257D	MY47461211	2024-01-12	One year
08	Amplifier	VTL5400	0404	/	/
09	DAE	DAE4	786	2023-12-11	One year
10	E-field Probe	EX3DV4	7621	2024-01-10	One year
11	Dipole Validation Kit	D2450V2	873	2021-10-21	Three years
12	Dipole Validation Kit	D5GHzV2	1238	2022-08-17	Three years
13	Thermometer	51II	99250045	2023-11-22	One year
14	Software	DASY5	/	/	/

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ANNEX A: Graph Results

Bluetooth Head/Body
Date: 2024-05-16
Electronics: DAE4 Sn786
Medium: Head 2450MHz
Medium parameters used: f = 2400 MHz; σ = 1.774 S/m; ε_r = 38.616; ρ = 1000 kg/m^3
Communication System: UID 0, BT (0) Frequency: 2400 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN7621 ConvF (8.21, 8.21, 8.21)

Top Side Ch.19/Area Scan (61x91x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.0553 W/kg

Top Side Ch.19/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 4.621 V/m; Power Drift = 0.16 dB
Peak SAR (extrapolated) = 0.0750 W/kg
SAR(1 g) = 0.041 W/kg; SAR(10 g) = 0.021 W/kg
Maximum value of SAR (measured) = 0.0557 W/kg

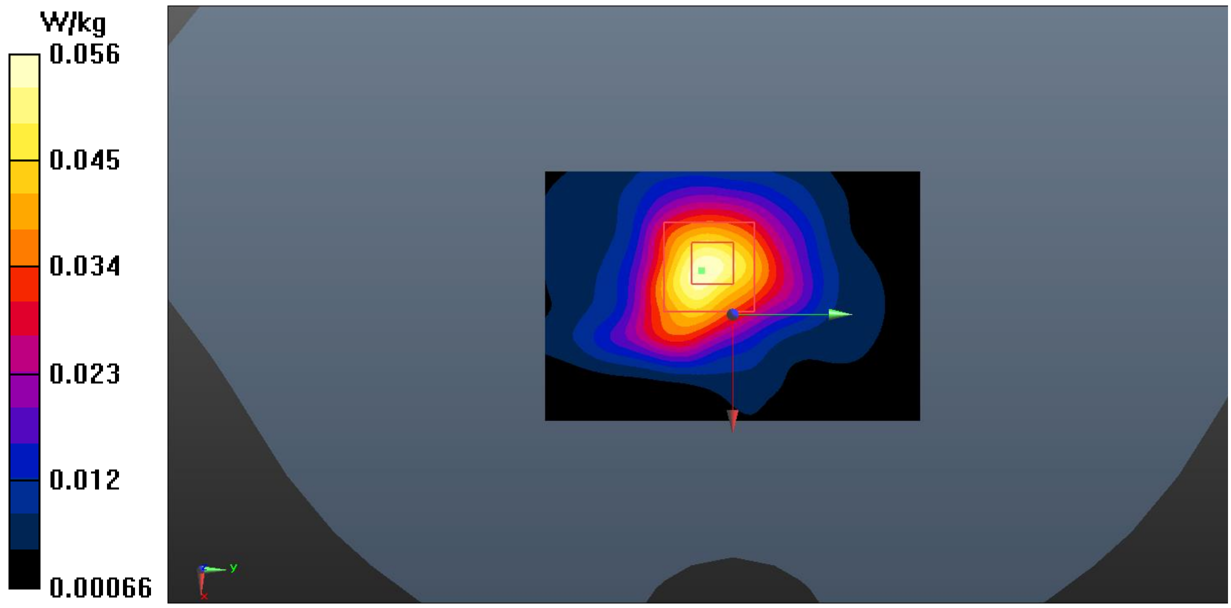

Fig.1 Bluetooth Head/Body

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WLAN 2.4GHz Head/Body
Date: 2024-05-16
Electronics: DAE4 Sn786
Medium: Head 2450MHz
Medium parameters used: f = 2412 MHz; σ = 1.788 S/m; ε_r = 38.576; ρ = 1000 kg/m^3
Communication System: UID 0, WLAN (0) Frequency: 2412 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN7621 ConvF (8.21, 8.21, 8.21)

Top Side Ch.1/Area Scan (61x91x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.571 W/kg

Top Side Ch.1/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 14.44 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 0.660 W/kg
SAR(1 g) = 0.365 W/kg; SAR(10 g) = 0.194 W/kg
Maximum value of SAR (measured) = 0.511 W/kg

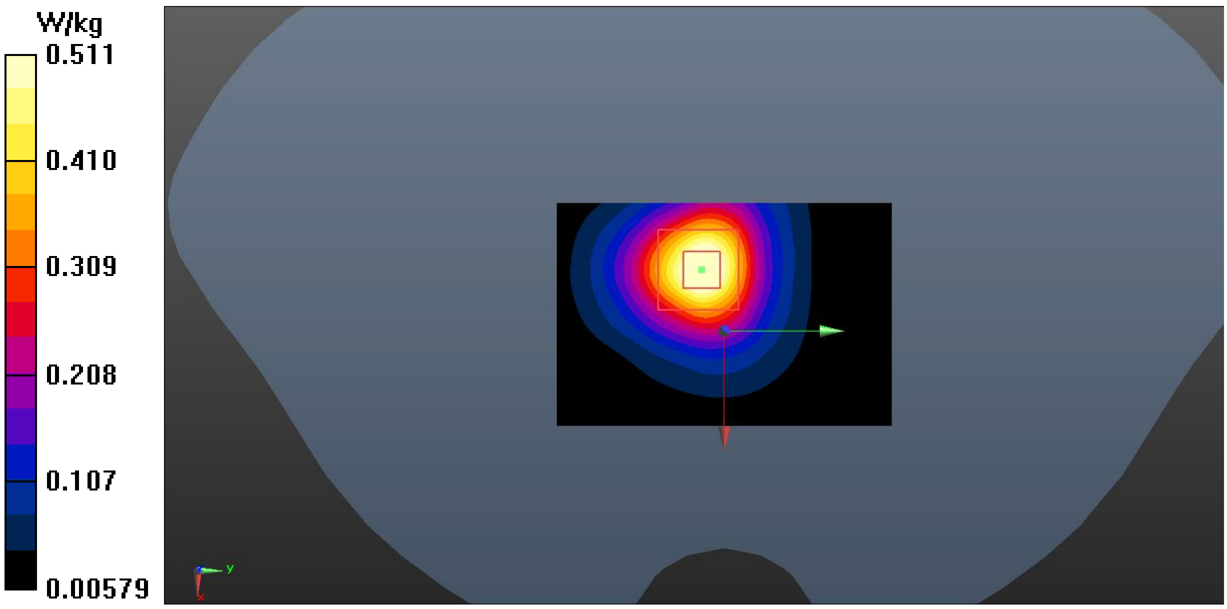

Fig.2 WLAN 2.4GHz Head/Body

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WLAN 5GHz Head/Body
Date: 2024-06-05
Electronics: DAE4 Sn786
Medium: Head 5600MHz
Medium parameters used: f = 5690 MHz; σ = 4.871 S/m; ε_r = 36.345; ρ = 1000 kg/m^3
Communication System: UID 0, WLAN 5G (0) Frequency: 5690 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN7621 ConvF (5.25, 5.25, 5.25)

Top Side Ch.138/Area Scan (71x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 2.06 W/kg

Top Side Ch.138/Zoom Scan (8x8x21)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 2.766 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 5.24 W/kg
SAR(1 g) = 1.28 W/kg; SAR(10 g) = 0.409 W/kg
Maximum value of SAR (measured) = 2.33 W/kg

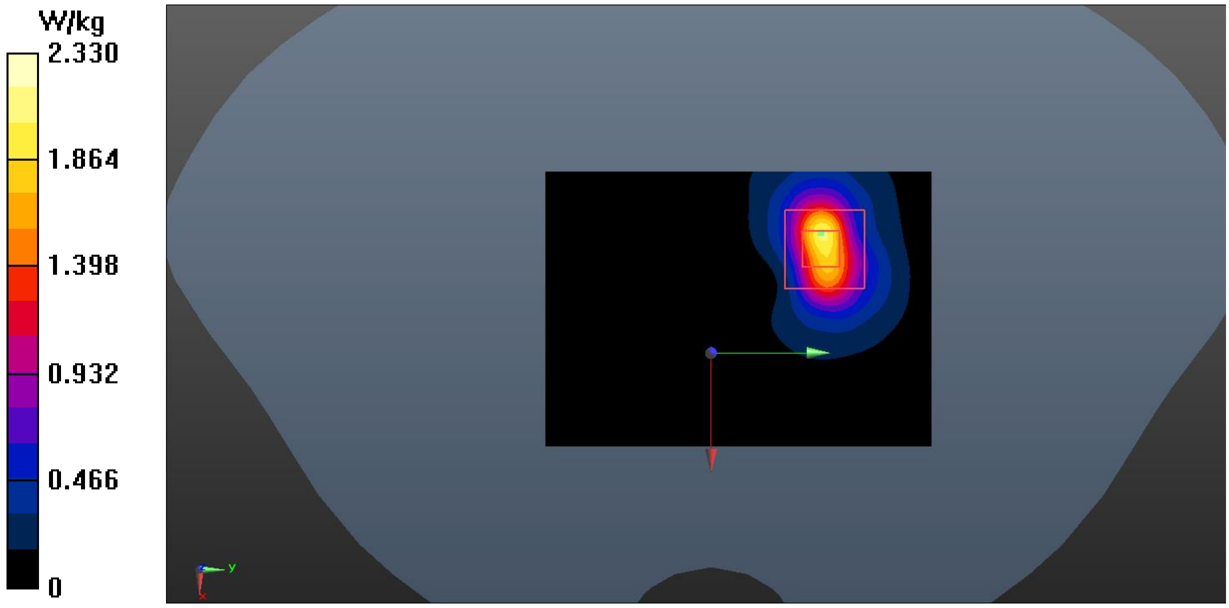

Fig.3 WLAN 5GHz Head/Body

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WLAN 5GHz Extremity
Date: 2024-06-05
Electronics: DAE4 Sn786
Medium: Head 5600MHz
Medium parameters used: f = 5690 MHz; σ = 4.871 S/m; ε_r = 36.345; ρ = 1000 kg/m^3
Communication System: UID 0, WLAN 5G (0) Frequency: 5690 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN7621 ConvF (5.25, 5.25, 5.25)

Top Side Ch.138/Area Scan (71x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 14.7 W/kg

Top Side Ch.138/Zoom Scan (8x8x21)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 3.478 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 37.3 W/kg
SAR(1 g) = 6.93 W/kg; SAR(10 g) = 1.51 W/kg
Maximum value of SAR (measured) = 16.9 W/kg

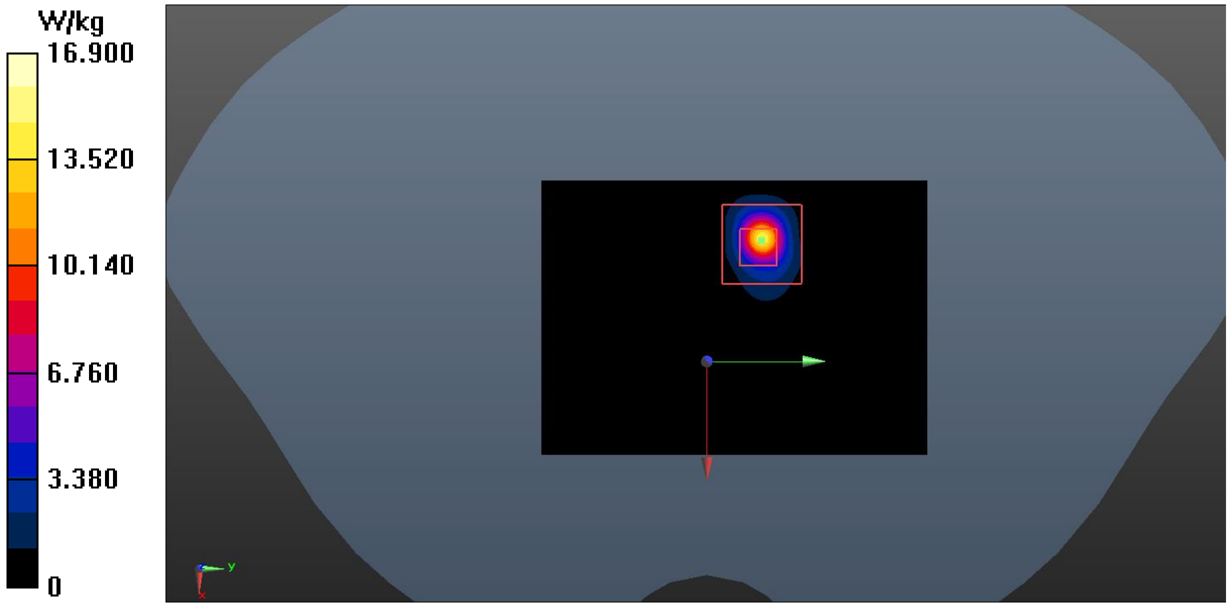

Fig.4 WLAN 5GHz Extremity

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ANNEX B: System Verification Results

2450MHz

Date: 2024-05-16

Electronics: DAE4 Sn786

Medium: Head 2450MHz

Medium parameters used: f = 2450 MHz; σ = 1.833 S/m; ε_r = 38.451; ρ = 1000 kg/m^3

Communication System: CW Frequency: 2450 MHz Duty Cycle: 1:1

Probe: EX3DV4 - SN7621 ConvF (8.21, 8.21, 8.21)

System Validation/Area Scan (81x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Reference Value = 92.458 V/m; Power Drift = 0.02 dB

SAR(1 g) = 13.6 W/kg; SAR(10 g) = 6.12 W/kg

Maximum value of SAR (interpolated) = 15.7 W/kg

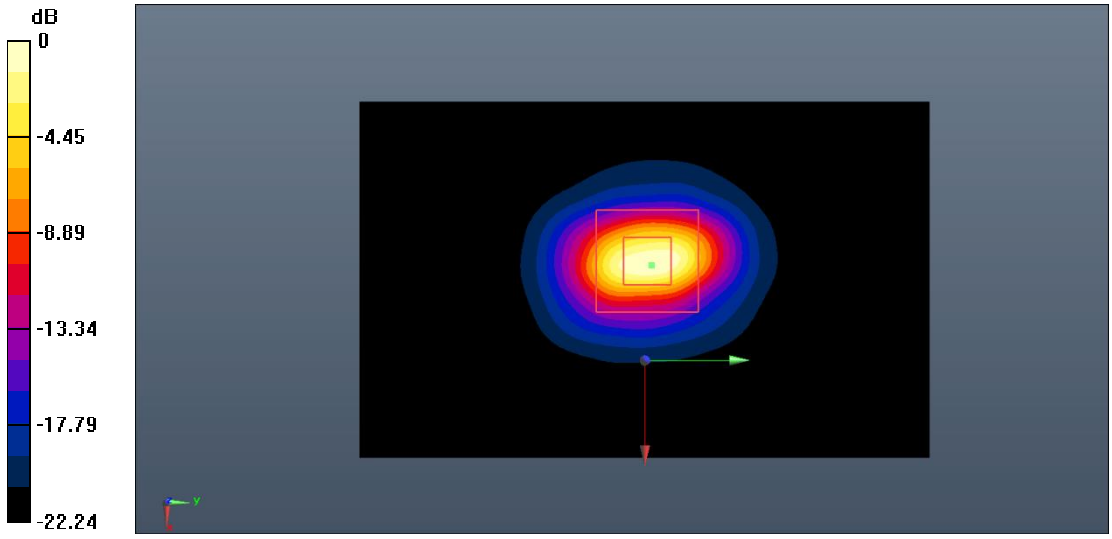
System Validation/Zoom Scan (7x7x7)/Cube0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 92.458 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 37.3 W/kg

SAR(1 g) = 13.8 W/kg; SAR(10 g) = 6.16 W/kg

Maximum value of SAR (measured) = 16.0 W/kg



0 dB = 16.0 W/kg = 12.04 dB W/kg

Fig.B.1. Validation 2450MHz 250mW

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5250MHz

Date: 2024-05-15

Electronics: DAE4 Sn786

Medium: Head 5250MHz

Medium parameters used: f = 5250 MHz; σ = 4.636 S/m; ε_r = 36.418; ρ = 1000 kg/m^3

Communication System: CW Frequency: 5250 MHz Duty Cycle: 1:1

Probe: EX3DV4 - SN7621 ConvF (5.95, 5.95, 5.95)

System Validation/Area Scan (61x91x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Reference Value = 65.456 V/m; Power Drift = -0.06 dB

SAR(1 g) = 7.93 W/kg; SAR(10 g) = 2.27 W/kg

Maximum value of SAR (interpolated) = 9.89 W/kg

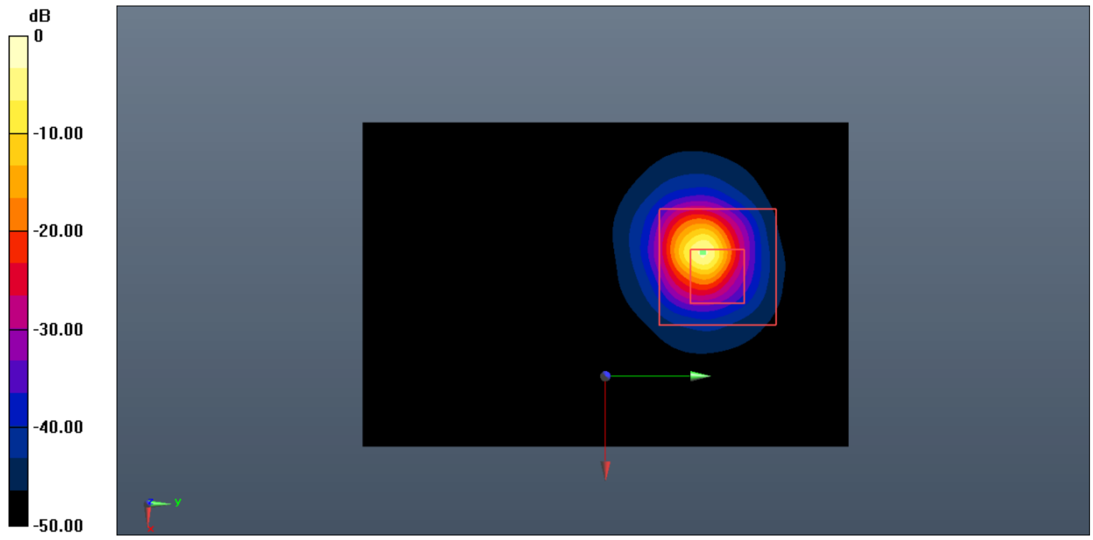
System Validation/Zoom Scan (8x8x21)/Cube0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 65.456 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 24.8 W/kg

SAR(1 g) = 7.70 W/kg; SAR(10 g) = 2.24 W/kg

Maximum value of SAR (measured) = 9.84 W/kg



0 dB = 9.84 W/kg = 9.93 dB W/kg

Fig.B.2. Validation 5250MHz 100mW

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5600MHz

Date: 2024-06-05

Electronics: DAE4 Sn786

Medium: Head 5600MHz

Medium parameters used: f = 5600 MHz; σ = 4.952 S/m; ε_r = 36.182; ρ = 1000 kg/m^3

Communication System: CW Frequency: 5600 MHz Duty Cycle: 1:1

Probe: EX3DV4 - SN7621 ConvF (5.25, 5.25, 5.25)

System Validation/Area Scan (61x91x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Reference Value = 66.039 V/m; Power Drift = -0.12 dB

SAR(1 g) = 8.17 W/kg; SAR(10 g) = 2.33 W/kg

Maximum value of SAR (interpolated) = 10.1 W/kg

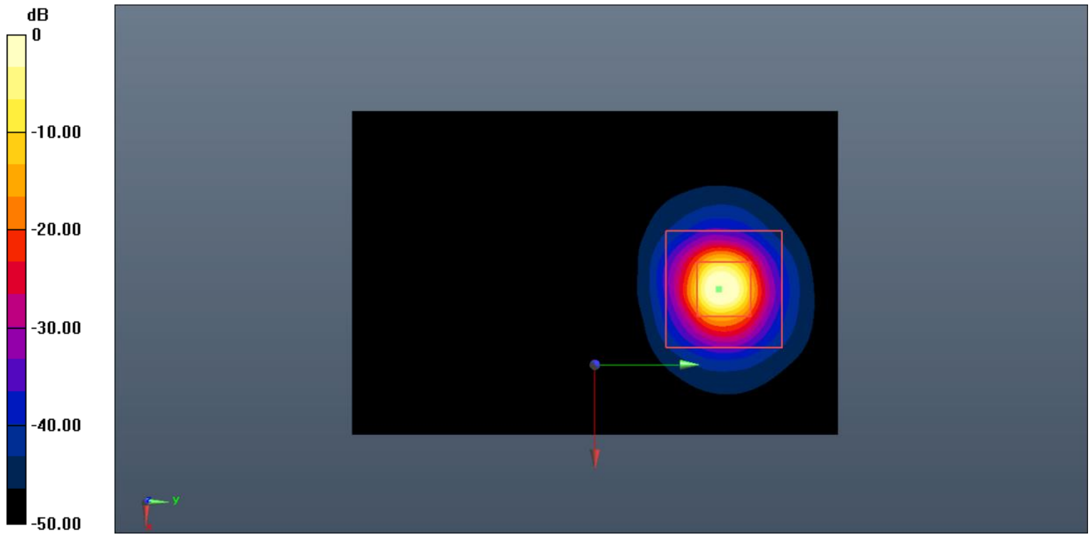
System Validation/Zoom Scan (8x8x21)/Cube0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 66.039 V/m; Power Drift = -0.12 dB

Peak SAR (extrapolated) = 25.6 W/kg

SAR(1 g) = 7.95 W/kg; SAR(10 g) = 2.31 W/kg

Maximum value of SAR (measured) = 9.96 W/kg



0 dB = 9.96 W/kg = 9.98 dB W/kg

Fig.B.3. Validation 5600MHz 100mW

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5750MHz

Date: 2024-05-15

Electronics: DAE4 Sn786

Medium: Head 5750MHz

Medium parameters used: f = 5750 MHz; σ = 5.313 S/m; ε_r = 34.685; ρ = 1000 kg/m^3

Communication System: CW Frequency: 5750 MHz Duty Cycle: 1:1

Probe: EX3DV4 - SN7621 ConvF (5.33, 5.33, 5.33)

System Validation/Area Scan (61x91x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Reference Value = 67.514 V/m; Power Drift = 0.05 dB

SAR(1 g) = 7.94 W/kg; SAR(10 g) = 2.22 W/kg

Maximum value of SAR (interpolated) = 10.0 W/kg

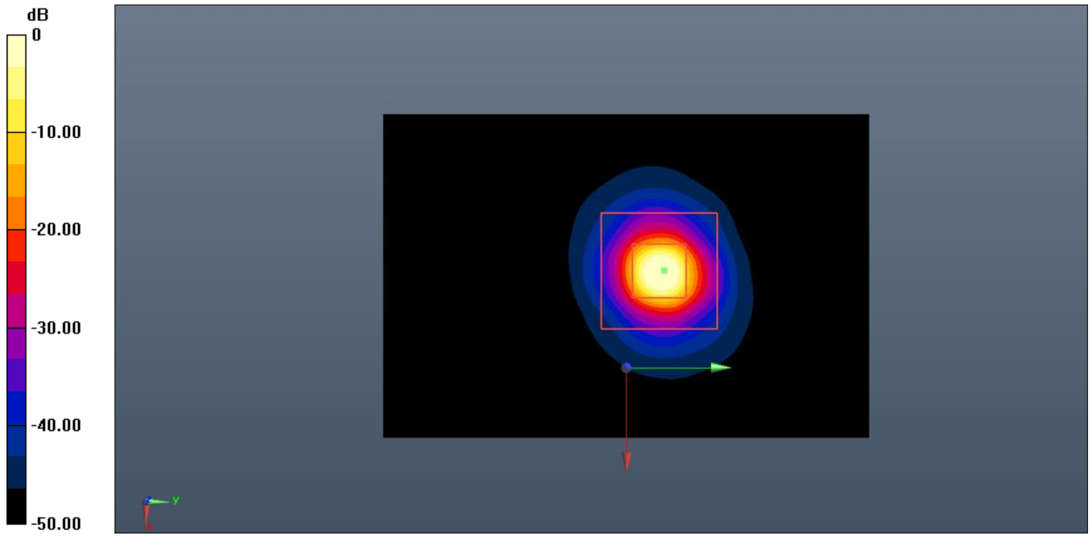
System Validation/Zoom Scan (8x8x21)/Cube0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 67.514 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 27.2 W/kg

SAR(1 g) = 8.07 W/kg; SAR(10 g) = 2.25 W/kg

Maximum value of SAR (measured) = 10.2 W/kg



0 dB = 10.2 W/kg = 10.09 dB W/kg

Fig.B.4. Validation 5750MHz 100mW

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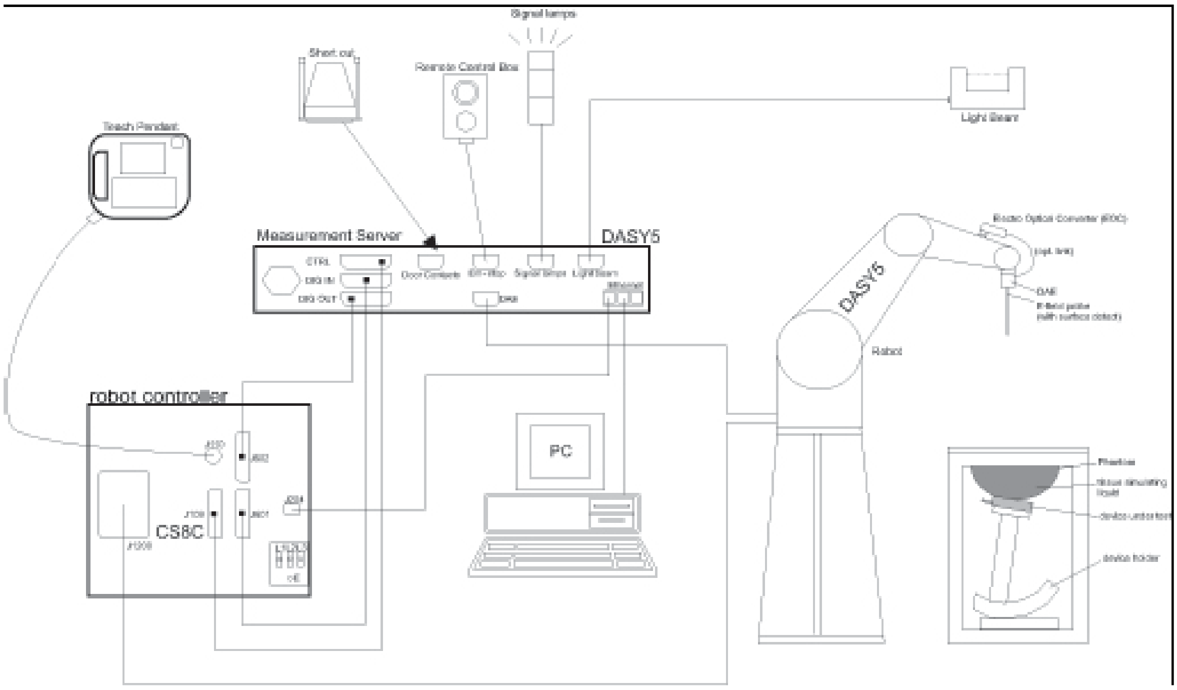
ANNEX C: SAR Measurement Setup

C.1. Measurement Set-up

The DASY5 or DASY8 system for performing compliance tests is illustrated above graphically. This system consists of the following items:



Picture C.1: SAR Lab Test Measurement Set-up

- A standard high precision 6-axis robot (Stäubli TX=RX family) 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 and the DASY5 OR DASY8 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.

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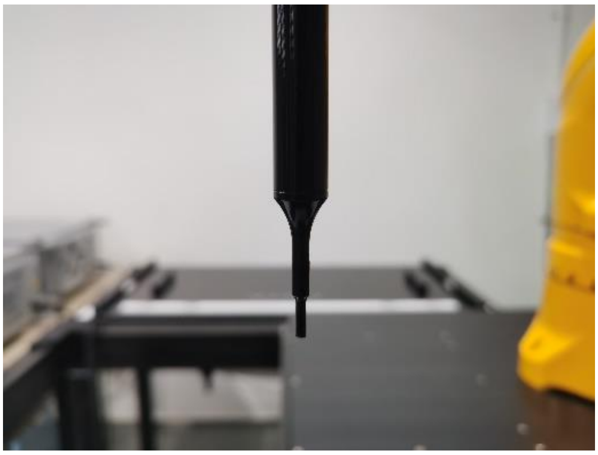
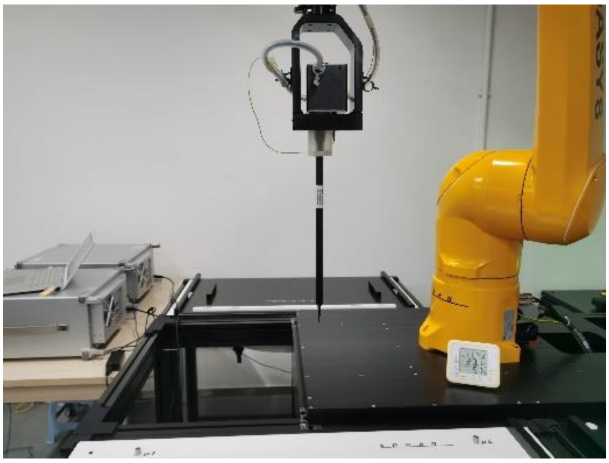
C.2. DASY E-field Probe System

The SAR measurements were conducted with the dosimetric probe designed in the classical triangular configuration and optimized for dosimetric evaluation. The probe is constructed using the thick film technique; with printed resistive lines on ceramic substrates. The probe is equipped with an optical multifiber line ending at the front of the probe tip. It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY5 OR DASY8 software reads the reflection durning a software approach and looks for the maximum using 2^{nd}ord curve fitting. The approach is stopped at reaching the maximum.

Probe Specifications:	
Model:	EX3DV4
Frequency Range:	10 MHz - 6.0 GHz
Calibration:	In head simulating tissue at Frequencies from 750 up to 5750 MHz
Linearity:	± 0.2 dB (30 MHz to 6 GHz)
Dynamic Range:	10 mW/kg - 100 W/kg
Probe Length:	337 mm
Probe Tip Length:	20 mm
Body Diameter:	12 mm
Tip Diameter:	2.5 mm
Tip-Center:	1 mm
Application:	SAR Dosimetry Testing / Compliance tests of mobile phones / Dosimetry in strong gradient fields


Picture C.2: Near-field Probe


Picture C.3: E-field Probe

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C.3. E-field Probe Calibration

Each E-Probe/Probe Amplifier combination has unique calibration parameters. A TEM cell calibration procedure is conducted to determine the proper amplifier settings to enter in the probe parameters. The amplifier settings are determined for a given frequency by subjecting the probe to a known E-field density (1 mW/cm^2) using an RF Signal generator, TEM cell, and RF Power Meter.

The free space E-field from amplified probe outputs is determined in a test chamber. This calibration can be performed in a TEM cell if the frequency is below 1 GHz and inn a waveguide or other methodologies above 1 GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity and at the proper orientation with the field. The probe is then rotated 360 degrees until the three channels show the maximum reading. The power density readings equates to 1 mW/ cm^2.

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated brain tissue. The E-field in the medium correlates with the temperature rise in the dielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe.

$$SAR = C\frac{\Delta T}{\Delta t}$$

Where:

Δt = Exposure time (30 seconds),

C = Heat capacity of tissue (brain or muscle),

ΔT = Temperature increase due to RF exposure.

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

Where:

σ = Simulated tissue conductivity,

ρ = Tissue density (kg/m^3).

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C.4. Other Test Equipment

C.4.1. Data Acquisition Electronics (DAE)

The data acquisition electronics consist 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 with a control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information, as well as an optical uplink for commands and the clock.

The mechanical probe mounting device includes two different sensor systems for frontal and sideways probe contacts. They are used for mechanical surface detection and probe collision detection.

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

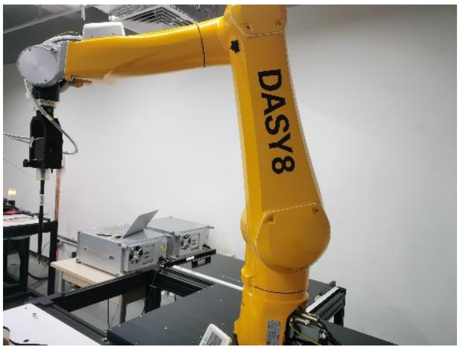
Picture C.4: DAE

C.4.2. Robot

The SPEAG DASY system uses the high precision robots (DASY5: RX90L) type from Stäubli SA (France). For the 6-axis controller system, the robot controller version from Stäubli is used. The Stäubli robot series have many features that are important for our application:

- High precision (repeatability 0.02mm)
- High reliability (industrial design)
- Low maintenance costs (virtually maintenance free due to direct drive gears; no belt drives)
- Jerk-free straight movements (brushless synchron motors; no stepper motors)
- Low ELF interference (motor control fields shielded via the closed metallic construction shields)

Picture C.5: DASY 5



Picture C.6: DASY 8

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C.4.3. Measurement Server

The Measurement server is based on a PC/104 CPU broad with CPU (DASY5: 400 MHz, Intel Celeron), chipdisk (DASY5:128MB), RAM (DASY5:128MB). The necessary circuits for communication with the DAE electronic box, as well as the 16 bit AD converter system for optical detection and digital I/O interface are contained on the DASY I/O broad, which is directly connected to the PC/104 bus of the CPU broad.

The measurement server performs all real-time data evaluation of field measurements and surface detection, controls robot movements and handles safety operation. The PC operating system cannot interfere with these time critical processes. All connections are supervised by a watchdog, and disconnection of any of the cables to the measurement server will automatically disarm the robot and disable all program-controlled robot movements. Furthermore, the measurement server is equipped with an expansion port which is reserved for future applications. Please note that this expansion port does not have a standardized pinout, and therefore only devices provided by SPEAG can be connected. Devices from any other supplier could seriously damage the measurement server.

Picture C.7: Server for DASY 5

Picture C.8: Server for DASY 8

C.4.4. Device Holder for Phantom

The SAR in the phantom is approximately inversely proportional to the square of the distance between the source and the liquid surface. For a source at 5mm distance, a positioning uncertainty of ±0.5mm would produce a SAR uncertainty of ±20%. Accurate device positioning is therefore crucial for accurate and repeatable measurements. The positions in which the devices must be measured are defined by the standards.

The DASY device holder is designed to cope with the different positions given in the standard. It has two scales for device rotation (with respect to the body axis) and device inclination (with respect to the line between the ear reference points). The rotation centers for both scales is the ear reference point (ERP). Thus the device needs no repositioning when changing the angles.

The DASY device holder is constructed of low-loss POM material having the following dielectric parameters: relative permittivity ε =3 and loss tangent δ =0.02. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.

<Laptop Extension Kit>

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 positioner. The extension is fully compatible with the Twin-SAM and ELI phantoms.

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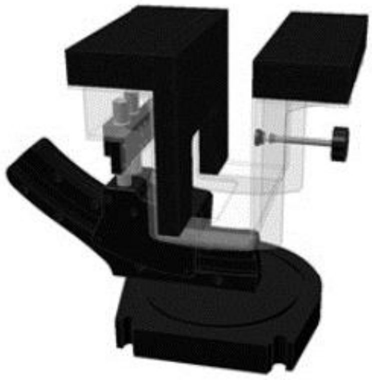
Picture C.9: Device Holder



Picture C.10: Laptop Extension Kit

The SAM Twin Phantom V4.0 is constructed of a fiberglass shell integrated in a table. The shape of the shell is based on data from an anatomical study designed to

Represent the 90th percentile of the population. The phantom enables the dissymmetric evaluation of SAR for both left and right handed handset usage, as well as body-worn usage using the flat phantom region. Reference markings on the Phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot. The shell phantom has a 2mm shell thickness (except the ear region where shell thickness increases to 6 mm).

Shell Thickness: 2 ± 0. 2 mm
Filling Volume: Approx. 25 liters
Dimensions: 810 x l000 x 500 mm (H x L x W)
Available: Special

Picture C.11: SAM Twin Phantom

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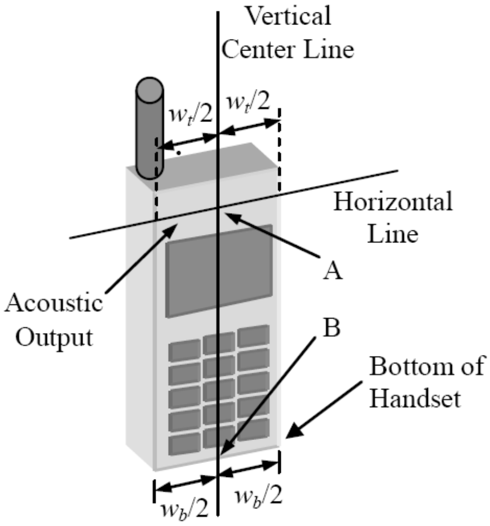
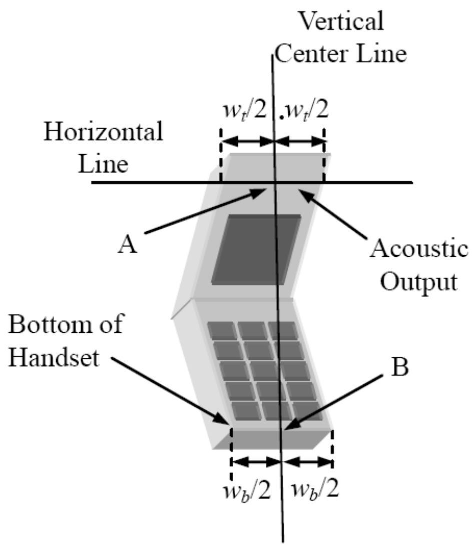
ANNEX D: Position of the wireless device in relation to the phantom

D.1. General considerations

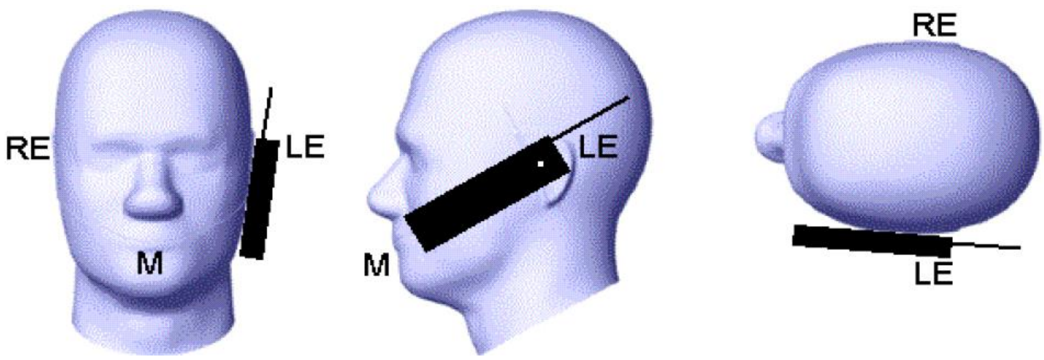
This standard specifies two handset test positions against the head phantom – the “cheek” position and the “tilt” position.





w_t	Width of the handset at the level of the acoustic
w_b	Width of the bottom of the handset
A	Midpoint of the width w_t of the handset at the level of the acoustic output
B	Midpoint of the width w_b of the bottom of the handset

Picture D.1-a Typical “fixed” case handset **Picture D.1-b Typical “clam-shell” case handset**



Picture D.2 Cheek position of the wireless device on the left side of SAM

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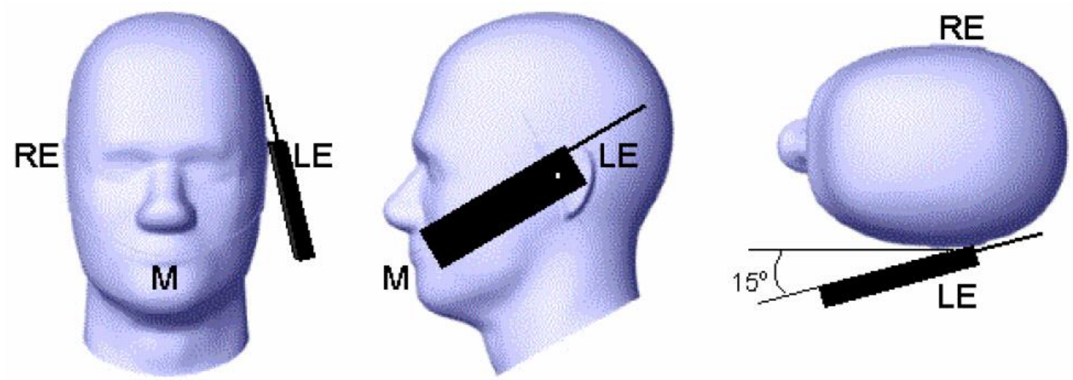
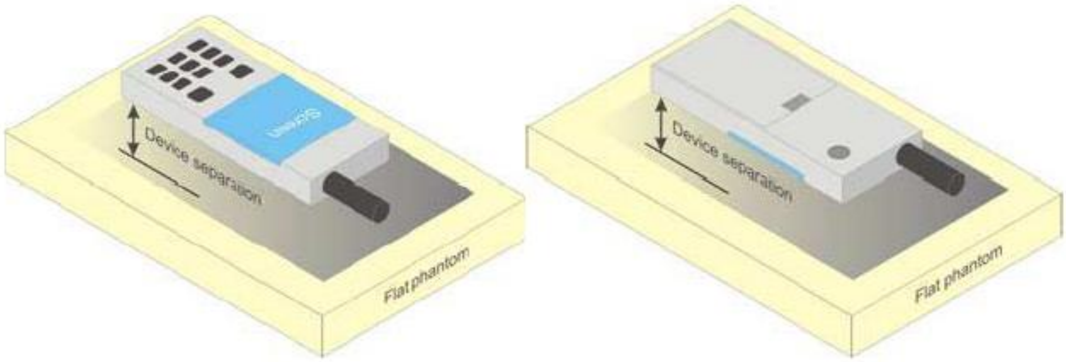


Picture D.3 Tilt position of the wireless device on the left side of SAM

D.2. Body-worn device

A typical example of a body-worn device is a mobile phone, wireless enabled PDA or other battery operated wireless device with the ability to transmit while mounted on a person's body using a carry accessory approved by the wireless device manufacturer.



Picture D.4 Test positions for body-worn devices

D.3. Desktop device

A typical example of a desktop device is a wireless enabled desktop computer placed on a table or desk when used.

The DUT shall be positioned at the distance and in the orientation to the phantom that corresponds to the intended use as specified by the manufacturer in the user instructions. For devices that employ an external antenna with variable positions, tests shall be performed for all antenna positions specified. Picture 8.5 show positions for desktop device SAR tests. If the intended use is not specified, the device shall be tested directly against the flat phantom.

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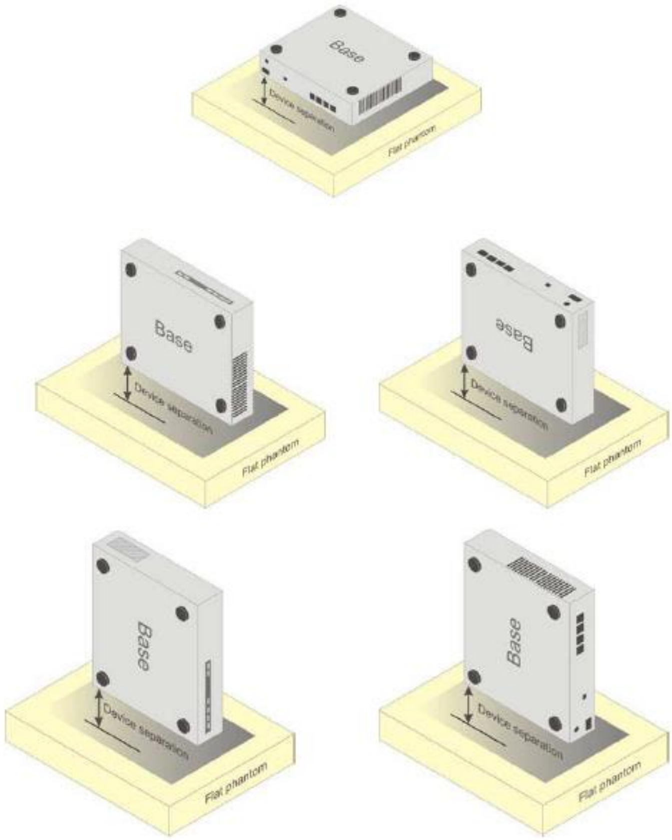

Picture D.5 Test positions for desktop devices

D.4. DUT Setup Photos

Picture D.6 Specific Absorption Rate Test Layout

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ANNEX E: Equivalent Media Recipes

The liquid used for the frequency range of 700-6000 MHz consisted of water, sugar, salt, preventol, glycol monobutyl and Cellulose. The liquid has been previously proven to be suited for worst-case. The Table E.1 shows the detail solution. It's satisfying the latest tissue dielectric parameters requirements proposed by the IEEE 1528 and IEC 62209.

Table E.1: Composition of the Tissue Equivalent Matter

Frequency (MHz)	835	1750	1900	2450	2600	5200	5800
Water	41.45	55.242	55.242	58.79	58.79	65.53	66.10
Sugar	56.0	/	/	/	/	/	/
Salt	1.45	0.306	0.306	0.06	0.06		
Preventol	0.1	/	/	/	/	17.24	16.95
Cellulose	1.0	/	/	/	/	17.24	16.95
Glycol Monobutyl	/	44.452	44.452	41.15	41.15	/	/
Diethylenglycol monohexylether	/	/	/	/	/	/	/
Triton X-100	/	/	/	/	/	/	/
Dielectric Parameters Target Value	ε=41.5 σ=0.90	ε=40.08 σ=1.37	ε=40.0 σ=1.40	ε=39.20 σ=1.80	ε=39.01 σ=1.96	ε=35.99 σ=4.66	ε=35.30 σ=5.27

Note: There is a little adjustment respectively for 750, 5300 and 5600, based on the recipe of closest frequency in table E.1

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ANNEX F: System Validation

The SAR system must be validated against its performance specifications before it is deployed. When SAR probes, system components or software are changed, upgraded or recalibrated, these must be validated with the SAR system(s) that operates with such components.

Table F.1: System Validation

Probe SN.	Liquid name (MHz)	Validation date	Frequency point	CW Validation	Modulation Signal Validation		
					Modulation Type	Duty Factor	PAR
7621	Head 750	2024-01-18	750MHz	Pass	N/A	N/A	N/A
7621	Head 835	2024-01-18	835MHz	Pass	GMSK	Pass	N/A
7621	Head 1750	2024-01-18	1750MHz	Pass	N/A	N/A	N/A
7621	Head 1900	2024-01-18	1900MHz	Pass	GMSK	Pass	N/A
7621	Head 2450	2024-01-20	2450MHz	Pass	OFDM/TDD	Pass	Pass
7621	Head 2550	2024-01-20	2550MHz	Pass	TDD	Pass	N/A
7621	Head 3500	2024-01-19	3500MHz	Pass	TDD	Pass	N/A
7621	Head 3700	2024-01-19	3700MHz	Pass	TDD	Pass	N/A
7621	Head 3900	2024-01-19	3900MHz	Pass	TDD	Pass	N/A
7621	Head 5250	2024-01-22	5250MHz	Pass	OFDM	N/A	Pass
7621	Head 5600	2024-01-22	5600MHz	Pass	OFDM	N/A	Pass
7621	Head 5750	2024-01-22	5750MHz	Pass	OFDM	N/A	Pass

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ANNEX G: DAE Calibration Certificate

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S **Servizio svizzero di taratura**
Swiss Calibration Service

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

Accreditation No.: SCS 0108

Client **SAICT**
Shenzhen

Certificate No: DAE4-786_Dec23

CALIBRATION CERTIFICATE

Object: DAE4 - SD 000 D04 BM - SN: 786

Calibration procedure(s): QA CAL-06.v30
Calibration procedure for the data acquisition electronics (DAE)

Calibration date: December 11, 2023

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 (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	29-Aug-23 (No:37421)	Aug-24
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Auto DAE Calibration Unit	SE UWS 053 AA 1001	27-Jan-23 (in house check)	In house check: Jan-24
Calibrator Box V2.1	SE UMS 006 AA 1002	27-Jan-23 (in house check)	In house check: Jan-24

	Name	Function	Signature
Calibrated by:	Dominique Steffen	Laboratory Technician	
Approved by:	Sven Kühn	Technical Manager	i.V.

Issued: December 11, 2023

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Certificate No: DAE4-786_Dec23 Page 1 of 5

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Accreditation No.: **SCS 0108**

Glossary

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

Methods Applied and Interpretation of Parameters

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle*: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
  - *DC Voltage Measurement Linearity:* Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
  - *Common mode sensitivity:* Influence of a positive or negative common mode voltage on the differential measurement.
  - *Channel separation:* Influence of a voltage on the neighbor channels not subject to an input voltage.
  - *AD Converter Values with inputs shorted:* Values on the internal AD converter corresponding to zero input voltage
  - *Input Offset Measurement*: Output voltage and statistical results over a large number of zero voltage measurements.
  - *Input Offset Current:* Typical value for information; Maximum channel input offset current, not considering the input resistance.
  - *Input resistance:* Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.
  - *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.
  - *Power consumption:* Typical value for information. Supply currents in various operating modes.

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DC Voltage Measurement

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

Calibration Factors	X	Y	Z
High Range	404.093 ± 0.02% (k=2)	404.226 ± 0.02% (k=2)	404.638 ± 0.02% (k=2)
Low Range	3.97228 ± 1.50% (k=2)	3.94201 ± 1.50% (k=2)	3.95929 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	331.0 ° ± 1 °

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Appendix (Additional assessments outside the scope of SCS0108)

1. DC Voltage Linearity

High Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	199986.65	1.02	0.00
Channel X	+ Input	19998.56	2.44	0.01
Channel X	- Input	-20002.95	4.99	-0.02
Channel Y	+ Input	199984.14	-1.62	-0.00
Channel Y	+ Input	19995.50	-0.73	-0.00
Channel Y	- Input	-20005.81	1.90	-0.01
Channel Z	+ Input	199983.31	-2.86	-0.00
Channel Z	+ Input	19996.62	0.41	0.00
Channel Z	- Input	-20004.38	3.36	-0.02

Low Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	1995.80	0.72	0.04
Channel X	+ Input	196.27	0.94	0.48
Channel X	- Input	-204.04	0.34	-0.17
Channel Y	+ Input	1995.03	-0.18	-0.01
Channel Y	+ Input	195.70	0.17	0.09
Channel Y	- Input	-205.47	-1.22	0.60
Channel Z	+ Input	1995.18	-0.00	-0.00
Channel Z	+ Input	194.54	-0.97	-0.50
Channel Z	- Input	-205.29	-1.05	0.51

2. Common mode sensitivity

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Common mode Input Voltage (mV)	High Range Average Reading (μV)	Low Range Average Reading (μV)
Channel X	200	14.09	11.76
	- 200	-10.45	-12.35
Channel Y	200	22.26	21.00
	- 200	-22.82	-22.83
Channel Z	200	7.79	7.64
	- 200	-9.85	-9.72

3. Channel separation

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Input Voltage (mV)	Channel X (μV)	Channel Y (μV)	Channel Z (μV)
Channel X	200	-	-2.10	-3.21
Channel Y	200	9.93	-	-0.01
Channel Z	200	7.19	7.69	-

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4. AD-Converter Values with inputs shorted

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	High Range (LSB)	Low Range (LSB)
Channel X	16083	14669
Channel Y	15939	15420
Channel Z	16116	13718

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec
Input 10MΩ

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	0.87	-1.01	1.96	0.50
Channel Y	-0.17	-1.30	1.23	0.46
Channel Z	-0.13	-1.47	0.93	0.48

6. Input Offset Current

Nominal Input circuitry offset current on all channels: <25fA

7. Input Resistance (Typical values for information)

	Zeroing (kOhm)	Measuring (MOhm)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

8. Low Battery Alarm Voltage (Typical values for information)

Typical values	Alarm Level (VDC)
Supply (+ Vcc)	+7.9
Supply (- Vcc)	-7.6

9. Power Consumption (Typical values for information)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.01	+6	+14
Supply (- Vcc)	-0.01	-8	-9

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ANNEX H: Probe Calibration Certificate

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中国认可 国际互认 校准 CALIBRATION CNAS L0570 CAICT

Client SAICT Certificate No: J23Z60349

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN : 7621
Calibration Procedure(s)	FF-Z11-004-02 Calibration Procedures for Dosimetric E-field Probes
Calibration date:	January 10, 2024

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)℃ 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	101919	12-Jun-23(CTTL, No.J23X05435)	Jun-24
Power sensor NRP-Z91	101547	12-Jun-23(CTTL, No.J23X05435)	Jun-24
Power sensor NRP-Z91	101548	12-Jun-23(CTTL, No.J23X05435)	Jun-24
Reference 10dBAttenuator	18N50W-10dB	19-Jan-23(CTTL, No.J23X00212)	Jan-25
Reference 20dBAttenuator	18N50W-20dB	19-Jan-23(CTTL, No.J23X00211)	Jan-25
Reference Probe EX3DV4	SN 3846	31-May-23(SPEAG, No.EX-3846_May23)	May-24
DAE4	SN 1555	24-Aug-23(SPEAG, No.DAE4-1555_Aug23)	Aug-24
Secondary Standards	**ID #**	**Cal Date(Calibrated by, Certificate No.)**	**Scheduled Calibration**
SignalGenerator MG3700A	6201052605	12-Jun-23(CTTL, No.J23X05434)	Jun-24
Network Analyzer E5071C	MY46110673	10-Jan-23(CTTL, No.J23X00104)	Jan-24
Reference 10dBAttenuator	BT0520	11-May-23(CTTL, No.J23X04061)	May-25
Reference 20dBAttenuator	BT0267	11-May-23(CTTL, No.J23X04062)	May-25
OCP DAK-12	SN 1174	25-Oct-23(SPEAG, No.OCP-DAK12-1174_Oct23)	Oct-24

	Name	Function	Signature
Calibrated by:	Yu Zongying	SAR Test Engineer	
Reviewed by:	Lin Jun	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: January 16, 2024

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Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013

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

c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010

d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization θ=0 (f≤900MHz in TEM-cell; f>1800MHz: waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not effect the E^2-field uncertainty inside TSL (see below ConvF).
- *NORM(f)x,y,z = NORMx,y,z* frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency nor media.
- PAR: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics.
- *Ax,y,z; Bx,y,z; Cx,y,z;VRx,y,z:*A,B,C are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f≤800MHz) and inside waveguide using analytical field distributions based on power measurements for f >800MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty valued are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORMx,y,z* ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from±50MHz to±100MHz.
- *Spherical isotropy (3D deviation from isotropy):* in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset:* The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- *Connector Angle:* The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 7621

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm(μV/(V/m)²)^A	0.75	0.69	0.56	±10.0%
DCP(mV)^B	116.3	111.8	114.1	

Calibration Results for Modulation Response

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Max Dev.	Max Unc^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	245.0	±2.2%	±4.7%
		Y	0.0	0.0	1.0		228.9		
		Z	0.0	0.0	1.0		200.2		
10352-AAA	Pulse Waveform (200Hz, 10%)	X	1.58	60.00	5.98	10.00	60	±4.6%	±9.6%
		Y	1.66	60.00	6.30		60		
		Z	1.55	60.00	5.90		60		
10353-AAA	Pulse Waveform (200Hz, 20%)	X	1.00	60.00	4.70	6.99	80	±5.0%	±9.6%
		Y	1.16	60.00	5.35		80		
		Z	0.88	60.00	4.61		80		
10354-AAA	Pulse Waveform (200Hz, 40%)	X	0.56	60.00	3.40	3.98	95	±4.2%	±9.6%
		Y	0.72	60.00	4.43		95		
		Z	0.13	135.25	0.44		95		
10355-AAA	Pulse Waveform (200Hz, 60%)	X	15.06	149.56	3.00	2.22	120	±2.5%	±9.6%
		Y	19.78	144.48	5.80		120		
		Z	0.04	157.67	14.77		120		
10387-AAA	QPSK Waveform, 1 MHz	X	0.67	62.21	9.98	1.00	150	±4.8%	±9.6%
		Y	0.60	62.87	11.02		150		
		Z	0.60	62.46	10.17		150		
10388-AAA	QPSK Waveform, 10 MHz	X	1.35	64.07	12.55	0.00	150	±1.4%	±9.6%
		Y	1.43	65.73	13.69		150		
		Z	1.31	64.32	12.60		150		
10396-AAA	64-QAM Waveform, 100 kHz	X	2.08	68.01	18.04	3.01	150	±1.0%	±9.6%
		Y	1.90	66.41	17.71		150		
		Z	2.09	68.06	18.19		150		
10414-AAA	WLAN CCDF, 64-QAM, 40MHz	X	4.04	65.58	14.84	0.00	150	±5.2%	±9.6%
		Y	4.02	66.13	15.30		150		
		Z	3.92	65.71	14.88		150		

Note: For details on UID parameters see Appendix

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

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

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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 7621

Sensor Model Parameters

	C1 fF	C2 fF	α V^{-1}	T1 $ms.V^{-2}$	T2 $ms.V^{-1}$	T3 ms	T4 V^{-2}	T5 V^{-1}	T6
X	15.06	105.97	31.62	5.46	0.00	4.90	0.72	0.00	1.02
Y	12.33	88.55	32.92	13.24	0.00	4.90	0.18	0.05	1.02
Z	12.49	87.81	31.63	2.66	0.00	4.90	0.76	0.00	1.02

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	136
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disable
Probe Overall Length	337mm
Probe Body Diameter	10mm
Tip Length	9mm
Tip Diameter	2.5mm
Probe Tip to Sensor X Calibration Point	1mm
Probe Tip to Sensor Y Calibration Point	1mm
Probe Tip to Sensor Z Calibration Point	1mm
Recommended Measurement Distance from Surface	1.4mm

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DASY/EASY – Parameters of Probe: EX3DV4 – SN:7621

Calibration Parameter Determined in Head Tissue Simulating Media

f [MHz][C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha[G]	Depth[G] (mm)	Unct. (k=2)
750	41.9	0.89	11.02	11.02	11.02	0.14	1.34	±12.7%
900	41.5	0.97	10.53	10.53	10.53	0.16	1.38	±12.7%
1750	40.1	1.37	9.11	9.11	9.11	0.24	0.99	±12.7%
1900	40.0	1.40	8.76	8.76	8.76	0.28	0.95	±12.7%
2100	39.8	1.49	8.72	8.72	8.72	0.26	1.01	±12.7%
2300	39.5	1.67	8.50	8.50	8.50	0.65	0.68	±12.7%
2450	39.2	1.80	8.21	8.21	8.21	0.67	0.67	±12.7%
2600	39.0	1.96	8.02	8.02	8.02	0.65	0.68	±12.7%
3300	38.2	2.71	7.70	7.70	7.70	0.43	0.95	±13.9%
3500	37.9	2.91	7.52	7.52	7.52	0.41	1.00	±13.9%
3700	37.7	3.12	7.31	7.31	7.31	0.43	1.04	±13.9%
3900	37.5	3.32	7.09	7.09	7.09	0.35	1.50	±13.9%
4100	37.2	3.53	7.10	7.10	7.10	0.40	1.15	±13.9%
5250	35.9	4.71	5.95	5.95	5.95	0.45	1.40	±13.9%
5600	35.5	5.07	5.25	5.25	5.25	0.50	1.35	±13.9%
5800	35.3	5.27	5.33	5.33	5.33	0.55	1.25	±13.9%

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

[F] At frequency up to 6 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ±10% if liquid compensation formula is applied to measured SAR values. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

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

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