



中认信通
CHINA CERTIFICATION ICT CO., LTD (DONGGUAN)



SAR TEST REPORT

Applicant: Yapalong Inc.

Address: 7895 Tranmere Drive, Unit 13, MISSISSAUGA, L5S 1V9 Canada

FCC ID: UJW-6000

Product Name: Yapalong

Model Number: Yapalong6000

Standard(s): 47 CFR Part 2(2.1093)

The above equipment has been tested and found compliant with the requirement of the relative standards by China Certification ICT Co., Ltd (Dongguan)

Report Number: CR22070055-20A

Date Of Issue: 2022-11-04

Reviewed By: Karl Gong

Karl Gong

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SAR TEST RESULTS SUMMARY

Operation Frequency Bands	Highest Reported 1g SAR (W/kg)	Limits (W/kg)
	Close to Body (Gap 0mm)	
SRD 900M	0.27	1.6
Maximum Simultaneous Transmission SAR		
Items	Close to Body (Gap 0mm)	Limits
Sum SAR(W/kg)	0.44	1.6
SPLSR	/	0.04
EUT Received Date:	2022/07/22	
Test Date:	2022/09/11	
Test Result:	Pass	

Test Facility

The Test site used by China Certification ICT Co., Ltd (Dongguan) to collect test data is located on the No. 113, Pingkang Road, Dalang Town, Dongguan, Guangdong, China.

The lab has been recognized as the FCC accredited lab under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No. : 442868, the FCC Designation No. : CN1314.

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: CN0123.

Declarations

China Certification ICT Co., Ltd (Dongguan) is not responsible for the authenticity of any test data provided by the applicant. Data included from the applicant that may affect test results are marked with a triangle symbol “▲”. Customer model name, addresses, names, trademarks etc. are not considered data.

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.

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1. GENERAL INFORMATION

1.1 Product Description for Equipment under Test (EUT)

Device Type:	Portable
Exposure Category:	Population / Uncontrolled
Antenna Type(s):	Internal Antenna
Body-Worn Accessories:	None
Operation modes:	SRD 900M and Bluetooth
Frequency Band:	SRD 900M: 903.401-926.651 MHz Bluetooth : 2402 MHz-2480 MHz
Conducted RF Power:	SRD 900M: 26.42 dBm Bluetooth(BDR/EDR): 9.84 dBm BLE: 6.96 dBm
Rated Input Voltage:	DC 3.7V from battery
Serial Number:	CR22070055-SA-S1
Normal Operation:	Colse to Body

1.2 Test Specification, Methods and Procedures

The tests documented in this report were performed in accordance with FCC 47 CFR § 2.1093, IEEE 1528-2013, the following FCC Published RF exposure KDB procedures:

KDB 447498 D01 General RF Exposure Guidance v06
KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04
KDB 865664 D02 RF Exposure Reporting v01r02

TCB Workshop April 2019: RF Exposure Procedures

1.3 SAR Limits

FCC Limit

EXPOSURE LIMITS	SAR (W/kg)	
	(General Population / Uncontrolled Exposure Environment)	(Occupational / Controlled Exposure Environment)
Spatial Average (averaged over the whole body)	0.08	0.4
Spatial Peak (averaged over any 1 g of tissue)	1.60	8.0
Spatial Peak (hands/wrists/feet/ankles averaged over 10 g)	4.0	20.0

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

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

General Population/Uncontrolled environments Spatial Peak limit 1.6W/kg for 1g Body SAR applied to the EUT.

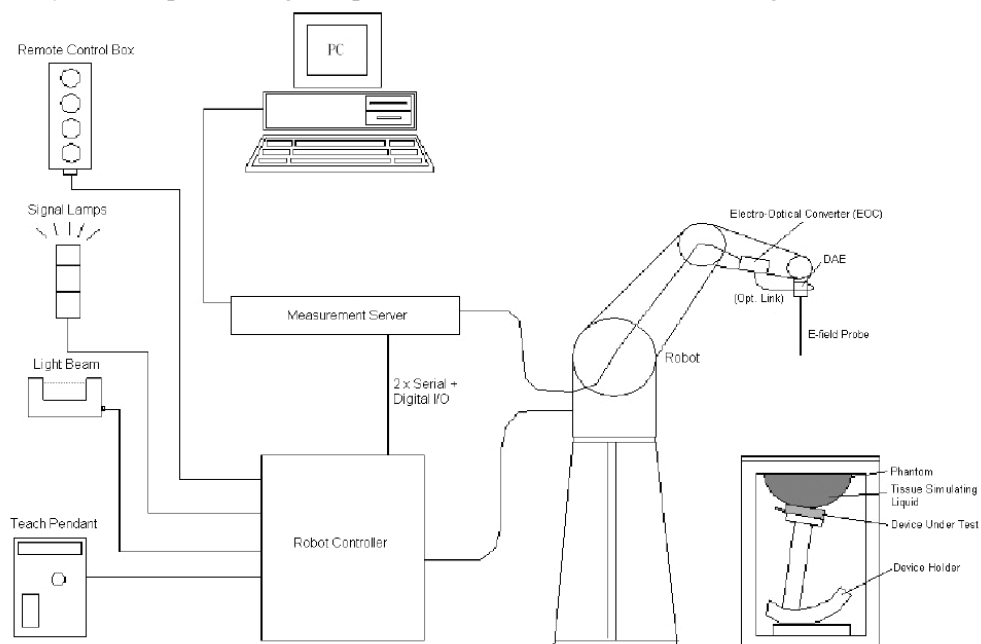
2. SAR MEASUREMENT SYSTEM

These measurements were performed with the automated near-field scanning system DASY5 from Schmid & Partner Engineering AG (SPEAG) which is the Fifth generation of the system shown in the figure hereinafter:



DASY5 System Description

The DASY5 system 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 application, 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 Win7 professional operating system and the DASY52 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.

DASY5 Measurement Server

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



The measurement server performs all real-time data evaluation 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 point out, and therefore only devices provided by SPEAG can be connected. Devices from any other supplier could seriously damage the measurement server.

Data Acquisition Electronics

The data acquisition electronics (DAE4) 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 both the DAE4 as well as of the DAE3 box is 200M Ω ; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

EX3DV4 E-Field Probes

Frequency	10 MHz to > 6 GHz Linearity: ± 0.2 dB (30 MHz to 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 μ W/g to > 100 mW/g Linearity: ± 0.2 dB (noise: typically < 1 μ W/g)
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm
Application	High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields); the only probe that enables compliance testing for frequencies up to 6 GHz with precision of better 30%.
Compatibility	DASY3, DASY4, DASY52 SAR and higher, EASY4/MRI

Calibration Frequency Points for EX3DV4 E-Field Probes SN: 7522 Calibrated: 2022/5/6

Calibration Frequency Point(MHz)	Frequency Range(MHz)		Conversion Factor		
	From	To	X	Y	Z
750 Head	650	850	9.70	9.70	9.70
900 Head	850	1000	9.24	9.24	9.24
1750 Head	1650	1850	8.10	8.10	8.10
1900 Head	1850	2000	7.79	7.79	7.79
2300 Head	2200	2400	7.50	7.50	7.50
2450 Head	2400	2550	7.22	7.22	7.22
2600 Head	2550	2700	7.02	7.02	7.02

SAM Twin Phantom

The SAM twin phantom is a fiberglass shell phantom with 2mm shell thickness (except the ear region, where shell thickness increases to 6 mm). The phantom has three measurement areas:

- _ Left Head
- _ Right Head
- _ Flat phantom

The phantom table for the DASY systems based on the robots have the size of 100 x 50 x 85 cm (L x W x H). For easy dislocation these tables have fork lift cut outs at the bottom.

The bottom plate contains three pairs of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. Only one device holder is necessary if two phantoms are used (e.g., for different liquids)



A white cover is provided to cover the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. Free space scans of devices on top of this phantom cover are possible. Three reference marks are provided on the phantom counter. These reference marks are used to teach the absolute phantom position relative to the robot.

Robots

The DASY5 system uses the high precision industrial robot. The robot offers the same features 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 synchrony motors; no stepper motors)
- Low ELF interference (motor control fields shielded via the closed metallic construction shields)

The above mentioned robots are controlled by the Staubli CS8c robot controllers. All information regarding the use and maintenance of the robot arm and the robot controller is contained on the CDs delivered along with the robot. Paper manuals are available upon request direct from Staubli.

SAR Scan Procedures

Step 1: 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. The minimum distance of probe sensors to surface is 1.4 mm. This distance cannot be smaller than the distance of sensor calibration points to probe tip as defined in the probe properties.

Step 2: Area Scans

Area scans are defined prior to the measurement process being executed with a user defined variable spacing between each measurement point (integral) allowing low uncertainty measurements to be conducted. Scans defined for FCC applications utilize a 15mm 2 step integral, with 1.5mm interpolation used to locate the peak SAR area used for zoom scan assessments.

Where the system identifies multiple SAR peaks (which are within 25% of peak value) the system will provide the user with the option of assessing each peak location individually for zoom scan averaging.

Area Scan Parameters extracted from KDB 865664 D01 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 mm \pm 1 mm	$\frac{1}{2} \cdot \delta \cdot \ln(2)$ mm \pm 0.5 mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	$30^\circ \pm 1^\circ$	$20^\circ \pm 1^\circ$
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 \leq the corresponding x or y dimension of the test device with at least one measurement point on the test device.	

Step 3: Zoom Scan (Cube Scan Averaging)

The averaging zoom scan volume utilized in the DASY5 software is in the shape of a cube and the side dimension of a 1 g or 10 g mass is dependent on the density of the liquid representing the simulated tissue. A density of 1000 kg/m³ is used to represent the head and body tissue density and not the phantom liquid density, in order to be consistent with the definition of the liquid dielectric properties, i.e. the side length of the 1g cube is 10mm, with the side length of the 10g cube is 21.5mm.

Zoom Scan Parameters extracted from KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz

			$\leq 3 \text{ GHz}$	$> 3 \text{ GHz}$
Maximum zoom scan spatial resolution: $\Delta x_{\text{Zoom}}, \Delta y_{\text{Zoom}}$			$\leq 2 \text{ GHz}: \leq 8 \text{ mm}$ $2 - 3 \text{ GHz}: \leq 5 \text{ mm}^*$	$3 - 4 \text{ GHz}: \leq 5 \text{ mm}^*$ $4 - 6 \text{ GHz}: \leq 4 \text{ mm}^*$
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{\text{Zoom}}(n)$		$\leq 5 \text{ mm}$	$3 - 4 \text{ GHz}: \leq 4 \text{ mm}$ $4 - 5 \text{ GHz}: \leq 3 \text{ mm}$ $5 - 6 \text{ GHz}: \leq 2 \text{ mm}$
	graded grid	$\Delta z_{\text{Zoom}}(1)$: between 1 st two points closest to phantom surface	$\leq 4 \text{ mm}$	$3 - 4 \text{ GHz}: \leq 3 \text{ mm}$ $4 - 5 \text{ GHz}: \leq 2.5 \text{ mm}$ $5 - 6 \text{ GHz}: \leq 2 \text{ mm}$
		$\Delta z_{\text{Zoom}}(n>1)$: between subsequent points	$\leq 1.5 \cdot \Delta z_{\text{Zoom}}(n-1) \text{ mm}$	
Minimum zoom scan volume	x, y, z		$\geq 30 \text{ mm}$	$3 - 4 \text{ GHz}: \geq 28 \text{ mm}$ $4 - 5 \text{ GHz}: \geq 25 \text{ mm}$ $5 - 6 \text{ GHz}: \geq 22 \text{ mm}$
Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see IEEE Std 1528-2013 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 Publication 447498 is $\leq 1.4 \text{ W/kg}$, $\leq 8 \text{ mm}$, $\leq 7 \text{ mm}$ and $\leq 5 \text{ mm}$ zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.				

Step 4: Power Drift Measurement

The Power Drift Measurement measures the field at the same location as the most recent power reference measurement within the same procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the last Power Reference Measurement. This allows a user to monitor the power drift of the device under test within a batch process. The measurement procedure is the same as Step 1.

When the cube intersects with the surface of the phantom, it is oriented so that 3 vertices touch the surface of the shell or the center of a face is tangent to the surface. The face of the cube closest to the surface is modified in order to conform to the tangent surface.

The zoom scan integer steps can be user defined so as to reduce uncertainty, but normal practice for typical test applications (including FCC) utilize a physical step of 7 x 7 x 7 (5mmx5mmx5mm) providing a volume of 30 mm in the X & Y & Z axis.

Tissue Dielectric Parameters for Head and Body Phantoms

The head tissue dielectric parameters recommended by the IEC 62209-1:2016

Recommended Tissue Dielectric Parameters for Head liquid

Table A.3 – Dielectric properties of the head tissue-equivalent liquid

Frequency MHz	Relative permittivity ϵ_r	Conductivity (σ) S/m
300	45,3	0,87
450	43,5	0,87
<i>750</i>	<i>41,9</i>	<i>0,89</i>
835	41,5	0,90
900	41,5	0,97
1 450	40,5	1,20
<i>1 500</i>	<i>40,4</i>	<i>1,23</i>
<i>1 640</i>	<i>40,2</i>	<i>1,31</i>
<i>1 750</i>	<i>40,1</i>	<i>1,37</i>
1 800	40,0	1,40
1 900	40,0	1,40
2 000	40,0	1,40
<i>2 100</i>	<i>39,8</i>	<i>1,49</i>
<i>2 300</i>	<i>39,5</i>	<i>1,67</i>
2 450	39,2	1,80
<i>2 600</i>	<i>39,0</i>	<i>1,96</i>
3 000	38,5	2,40
<i>3 500</i>	<i>37,9</i>	<i>2,91</i>
<i>4 000</i>	<i>37,4</i>	<i>3,43</i>
<i>4 500</i>	<i>36,8</i>	<i>3,94</i>
<i>5 000</i>	<i>36,2</i>	<i>4,45</i>
<i>5 200</i>	<i>36,0</i>	<i>4,66</i>
<i>5 400</i>	<i>35,8</i>	<i>4,86</i>
<i>5 600</i>	<i>35,5</i>	<i>5,07</i>
<i>5 800</i>	<i>35,3</i>	<i>5,27</i>
<i>6 000</i>	<i>35,1</i>	<i>5,48</i>

NOTE For convenience, permittivity and conductivity values at those frequencies which are not part of the original data provided by Drossos et al. [33] or the extension to 5 800 MHz are provided (i.e. the values shown *in italics*). These values were linearly interpolated between the values in this table that are immediately above and below these values, except the values at 6 000 MHz that were linearly extrapolated from the values at 3 000 MHz and 5 800 MHz.

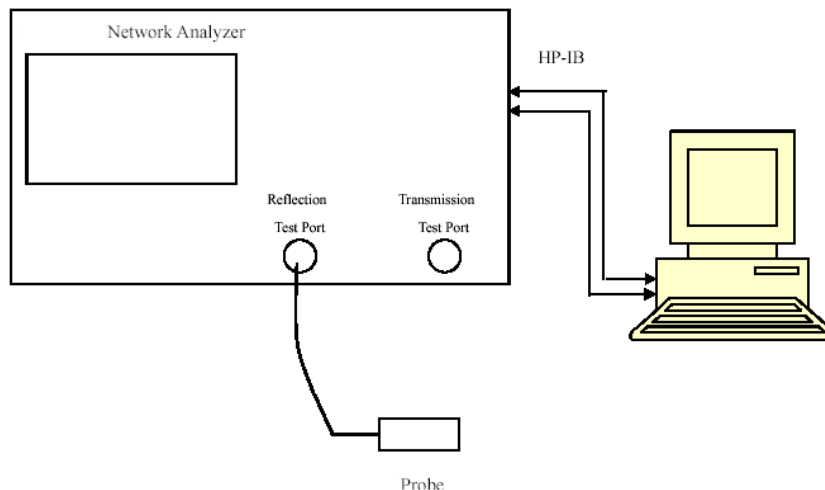
3. EQUIPMENT LIST AND CALIBRATION

3.1 Equipments List & Calibration Information

Equipment	Model	S/N	Calibration Date	Calibration Due Date
DASY5 Test Software	DASY52.10	N/A	NCR	NCR
DASY5 Measurement Server	DASY5 4.5.12	1567	NCR	NCR
Data Acquisition Electronics	DAE4	1325	2022/8/29	2023/8/28
E-Field Probe	EX3DV4	7522	2022/5/6	2023/5/5
Mounting Device	MD4HHTV5	BJPCTC0152	NCR	NCR
Twin SAM	Twin SAM V5.0	1412	NCR	NCR
Dipole, 900 MHz	D900V2	1d183	2021/8/27	2024/8/26
Simulated Tissue Liquid Head(500-9500 MHz)	HBBL600-10000V6	220420-2	Each Time	/
Network Analyzer	8753B	2828A00170	2021/10/26	2022/10/25
Dielectric assessment kit	1253	SM DAK 040 CA	NCR	NCR
MXG Vector Signal Generator	N5182B	MY51350144	2022/7/15	2023/7/14
Power Meter	EPM-441A/8484A	GB37481494	2022/7/15	2023/7/14
Power Amplifier	ZVA-183-S+	5969001149	NCR	NCR
Directional Coupler	441493	520Z	NCR	NCR
Attenuator	20dB, 100W	LN749	NCR	NCR
Attenuator	6dB, 150W	2754	NCR	NCR

4. SAR MEASUREMENT SYSTEM VERIFICATION

4.1 Liquid Verification



Liquid Verification Setup Block Diagram

Liquid Verification Results

Frequency (MHz)	Liquid Type	Liquid Parameter		Target Value		Delta (%)		Tolerance (%)
		ϵ_r	σ (S/m)	ϵ_r	σ (S/m)	$\Delta\epsilon_r$	$\Delta\sigma$ (S/m)	
900	Simulated Tissue 900 MHz	41.819	0.937	41.5	0.97	0.77	-3.4	± 5
903.401	Simulated Tissue 900 MHz	41.693	0.951	41.49	0.97	0.49	-1.96	± 5
915.401	Simulated Tissue 900 MHz	41.284	0.972	41.47	0.98	-0.45	-0.82	± 5
926.651	Simulated Tissue 900 MHz	40.892	0.996	41.45	0.98	-1.35	1.63	± 5

*Liquid Verification above was performed on 2022/09/11.

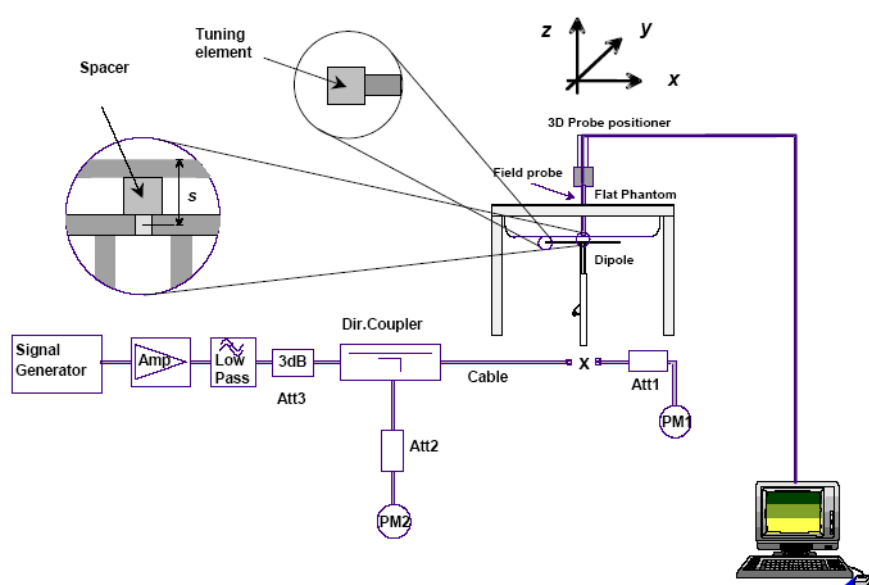
4.2 System Accuracy Verification

Prior to the assessment, the system validation kit was used to test whether the system was operating within its specifications of $\pm 10\%$. The validation results are tabulated below. And also the corresponding SAR plot is attached as well in the SAR plots files.

The spacing distances in the **System Verification Setup Block Diagram** is given by the following:

- $s = 15 \text{ mm} \pm 0,2 \text{ mm}$ for $300 \text{ MHz} \leq f \leq 1\,000 \text{ MHz}$;
- $s = 10 \text{ mm} \pm 0,2 \text{ mm}$ for $1\,000 \text{ MHz} < f \leq 3\,000 \text{ MHz}$;
- $s = 10 \text{ mm} \pm 0,2 \text{ mm}$ for $3\,000 \text{ MHz} < f \leq 6\,000 \text{ MHz}$.

System Verification Setup Block Diagram



System Accuracy Check Results

Date	Frequency Band	Liquid Type	Input Power (mW)	Measured SAR (W/kg)		Normalized to 1W (W/kg)	Target Value (W/kg)	Delta (%)	Tolerance (%)
2022/09/11	900 MHz	Simulated Tissue 900 MHz	100	1g	1.15	11.5	10.9	5.5	± 10

*The SAR values above are normalized to 1 Watt forward power.

4.3 SAR SYSTEM VALIDATION DATA

System Performance 900MHz

DUT: D900V2; Type: 900 MHz; Serial: 1d183

Communication System: CW; Frequency: 900 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 900 \text{ MHz}$; $\sigma = 0.937 \text{ S/m}$; $\epsilon_r = 41.819$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7522; ConvF(9.24, 9.24, 9.24) @ 900 MHz; Calibrated: 2022/5/6
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1325; Calibrated: 2022/8/29
- Phantom: Twin SAM; Type: Twin SAM V5.0; Serial: TP:1412
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7470)

Area Scan (81x121x1): Interpolated grid: $dx=1.500 \text{ mm}$, $dy=1.500 \text{ mm}$

Maximum value of SAR (interpolated) = 1.59 W/kg

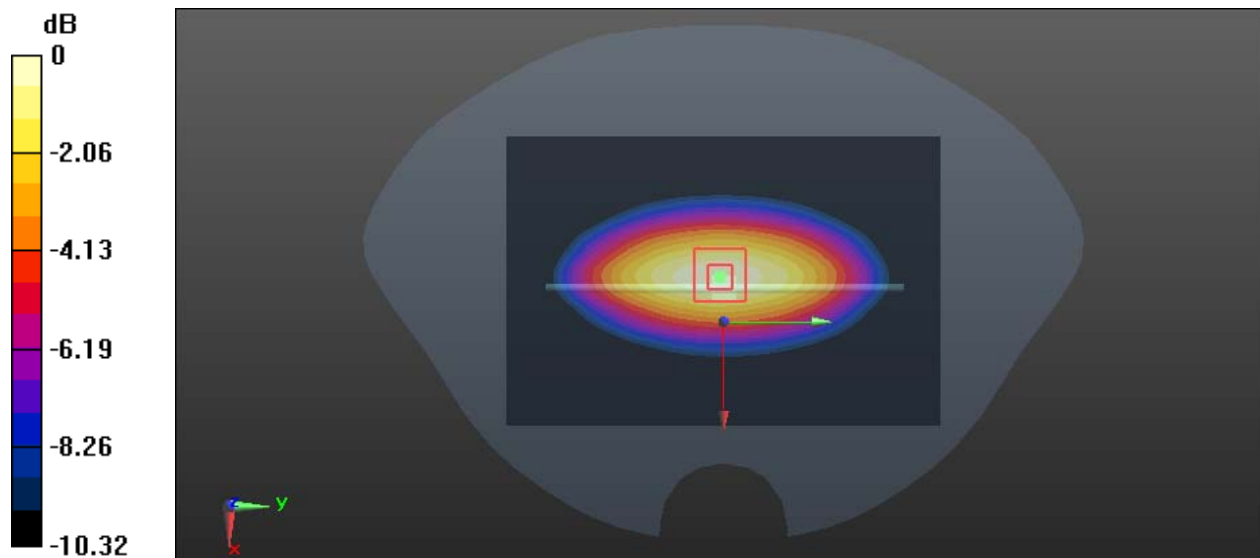
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 36.37 V/m ; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 1.83 W/kg

SAR(1 g) = 1.15 W/kg ; SAR(10 g) = 0.722 W/kg

Maximum value of SAR (measured) = 1.58 W/kg



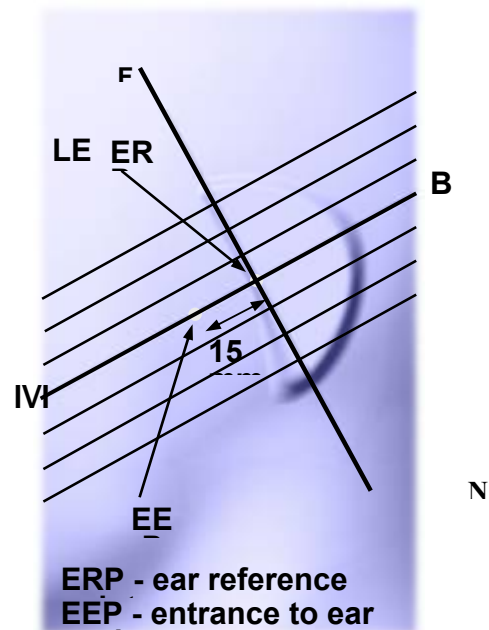
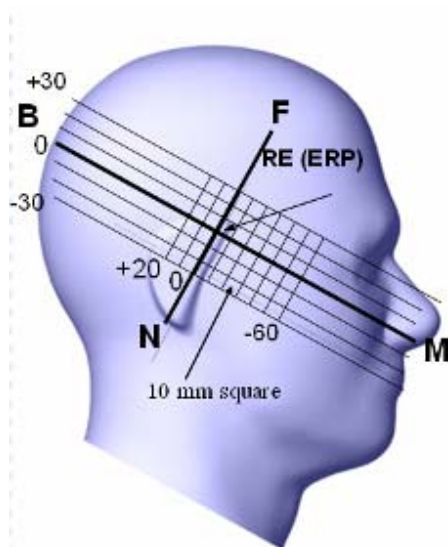
$0 \text{ dB} = 1.58 \text{ W/kg} = 1.99 \text{ dBW/kg}$

5. EUT TEST STRATEGY AND METHODOLOGY

5.1 Test Positions for Device Operating Next to a Person's Ear

This category includes most wireless handsets with fixed, retractable or internal antennas located toward the top half of the device, with or without a foldout, sliding or similar keypad cover. The handset should have its earpiece located within the upper ¼ of the device, either along the centerline or off-centered, as perceived by its users. This type of handset should be positioned in a normal operating position with the “test device reference point” located along the “vertical centerline” on the front of the device aligned to the “ear reference point”. The “test device reference point” should be located at the same level as the center of the earpiece region. The “vertical centerline” should bisect the front surface of the handset at its top and bottom edges. A “ear reference point” is located on the outer surface of the head phantom on each ear spacer. It is located 1.5 cm above the center of the ear canal entrance in the “phantom reference plane” defined by the three lines joining the center of each “ear reference point” (left and right) and the tip of the mouth.

A handset should be initially positioned with the earpiece region pressed against the ear spacer of a head phantom. For the SCC-34/SC-2 head phantom, the device should be positioned parallel to the “N-F” line defined along the base of the ear spacer that contains the “ear reference point”. For interim head phantoms, the device should be positioned parallel to the cheek for maximum RF energy coupling. The “test device reference point” is aligned to the “ear reference point” on the head phantom and the “vertical centerline” is aligned to the “phantom reference plane”. This is called the “initial ear position”. While maintaining these three alignments, the body of the handset is gradually adjusted to each of the following positions for evaluating SAR:



5.2 Cheek/Touch Position

The device is brought toward the mouth of the head phantom by pivoting against the “ear reference point” or along the “N-F” line for the SCC-34/SC-2 head phantom.

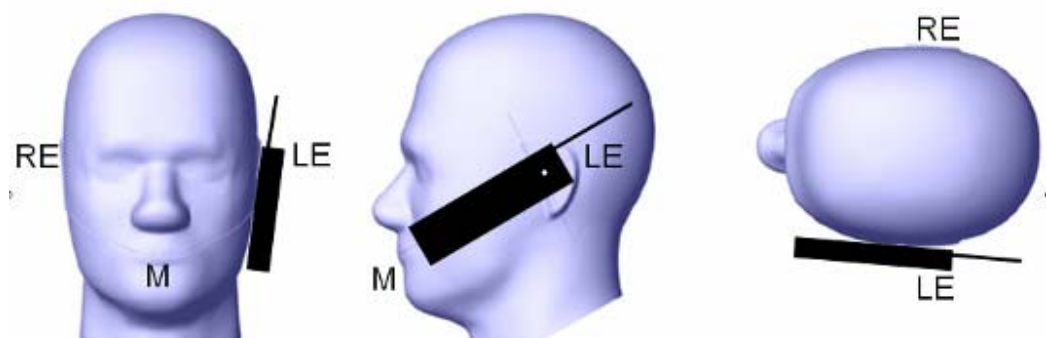
This test position is established:

When any point on the display, keypad or mouthpiece portions of the handset is in contact with the phantom.

(or) When any portion of a foldout, sliding or similar keypad cover opened to its intended self-adjusting normal use position is in contact with the cheek or mouth of the phantom.

For existing head phantoms – when the handset loses contact with the phantom at the pivoting point, rotation should continue until the device touches the cheek of the phantom or breaks its last contact from the ear spacer.

Cheek /Touch Position



5.3 Ear/Tilt Position

With the handset aligned in the “Cheek/Touch Position”:

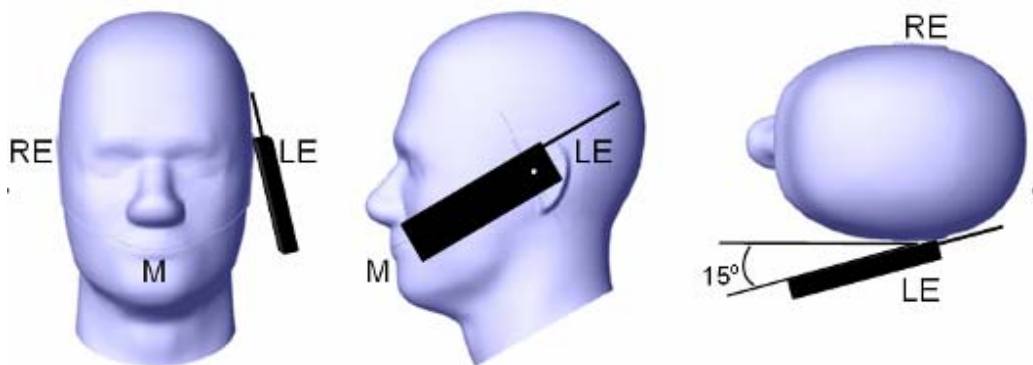
1) If the earpiece of the handset is not in full contact with the phantom’s ear spacer (in the “Cheek/Touch position”) and the peak SAR location for the “Cheek/Touch” position is located at the ear spacer region or corresponds to the earpiece region of the handset, the device should be returned to the “initial ear position” by rotating it away from the mouth until the earpiece is in full contact with the ear spacer.

2) (otherwise) The handset should be moved (translated) away from the cheek perpendicular to the line passes through both “ear reference points” (note: one of these ear reference points may not physically exist on a split head model) for approximate 2-3 cm. While it is in this position, the device handset is tilted away from the mouth with respect to the “test device reference point” until the inside angle between the vertical centerline on the front surface of the phone and the horizontal line passing through the ear reference point is by 15 80°. After the tilt, it is then moved (translated) back toward the head perpendicular to the line passes through both “ear reference points” until the device touches the phantom or the ear spacer. If the antenna touches the head first, the positioning process should be repeated with a tilt angle less than 15° so that the device and its antenna would touch the phantom simultaneously. This test position may require a device holder or positioner to achieve the translation and tilting with acceptable positioning repeatability.

If a device is also designed to transmit with its keypad cover closed for operating in the head position, such positions should also be considered in the SAR evaluation. The device should be tested on the left and

right side of the head phantom in the “Cheek/Touch” and “Ear/Tilt” positions. When applicable, each configuration should be tested with the antenna in its fully extended and fully retracted positions. These test configurations should be tested at the high, middle and low frequency channels of each operating mode; for example, AMPS, CDMA, and TDMA. If the SAR measured at the middle channel for each test configuration (left, right, Cheek/Touch, Tilt/Ear, extended and retracted) is at least 2.0 dB lower than the SAR limit, testing at the high and low channels is optional for such test configuration(s). If the transmission band of the test device is less than 10 MHz, testing at the high and low frequency channels is optional.

Ear /Tilt 15° Position



5.4 Test positions for body-worn and other configurations

Body-worn operating configurations should be tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in normal use configurations. Devices with a headset output should be tested with a headset connected to the device. When multiple accessories that do not contain metallic components are supplied with the device, the device may be tested with only the accessory that dictates the closest spacing to the body. When multiple accessories that contain metallic components are supplied with the device, the device must be tested with each accessory that contains a unique metallic component. If multiple accessories share an identical metallic component (e.g., the same metallic belt-clip used with different holsters with no other metallic components), only the accessory that dictates the closest spacing to the body must be tested.

Body-worn accessories may not always be supplied or available as options for some devices that are intended to be authorized for body-worn use. A separation distance of 1.5 cm between the back of the device and a flat phantom is recommended for testing body-worn SAR compliance under such circumstances. Other separation distances may be used, but they should not exceed 2.5 cm. In these cases, the device may use body-worn accessories that provide a separation distance greater than that tested for the device provided however that the accessory contains no metallic components.

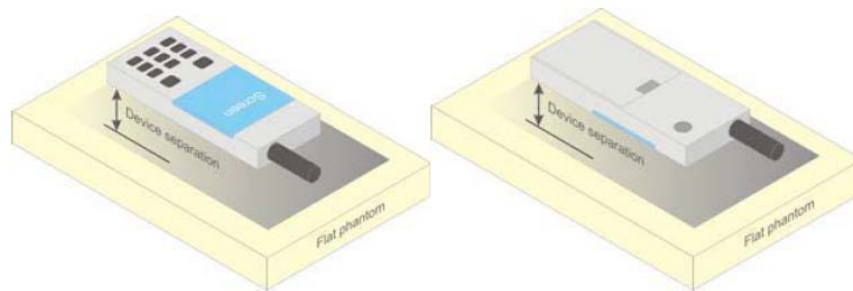


Figure 5 – Test positions for body-worn devices

5.5 Test Distance for SAR Evaluation

In this case the EUT(Equipment Under Test) is set 0mm away from the phantom, the test distance is 0mm.

5.6 SAR Evaluation Procedure

The evaluation was performed with the following procedure:

Step 1: Measurement of the SAR value at a fixed location above the ear point or central position was used as a reference value for assessing the power drop. The SAR at this point is measured at the start of the test and then again at the end of the testing.

Step 2: The SAR distribution at the exposed side of the head was measured at a distance of 4 mm from the inner surface of the shell. The area covered the entire dimension of the head or radiating structures of the EUT, the horizontal grid spacing was 15 mm x 15 mm, and the SAR distribution was determined by integrated grid of 1.5mm x 1.5mm. Based on these data, the area of the maximum absorption was determined by spline interpolation. The first Area Scan covers the entire dimension of the EUT to ensure that the hotspot was correctly identified.

Step 3: Around this point, a volume of 30 mm x 30 mm x 30 mm was assessed by measuring 7x 7 x 7 points. On the basis of this data set, the spatial peak SAR value was evaluated under the following procedure:

- 1) The data at the surface were extrapolated, since the center of the dipoles is 1.2 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 1.3 mm. The extrapolation was based on a least square algorithm. A polynomial of the fourth order was calculated through the points in z-axes. This polynomial was then used to evaluate the points between the surface and the probe tip.

- 2) The maximum interpolated value was searched with a straightforward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1 g or 10 g) were computed by the 3D-Spline interpolation algorithm. The 3D-Spline is composed of three one dimensional splines with the "Not a knot"-condition (in x, y and z-directions). The volume was integrated with the trapezoidal-algorithm. One thousand points (10 x 10 x 10) were interpolated to calculate the averages.

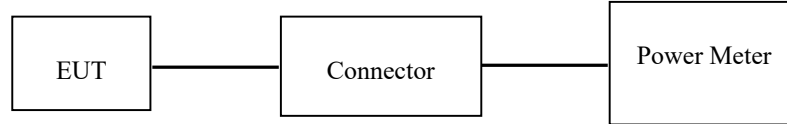
All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.

Step 4: Re-measurement of the SAR value at the same location as in Step 1. If the value changed by more than 5%, the evaluation was repeated.

6. CONDUCTED OUTPUT POWER MEASUREMENT

6.1 Test Procedure

The RF output of the transmitter was connected to the input of the Power Meter through Connector.



SRD

6.2 Maximum Target Output Power

Max Target Power(dBm)			
Mode/Band	Channel		
	Low	Middle	High
SRD 900M	26.5	26.5	26.5
Bluetooth BDR/EDR	10.0	10.0	10.0
BLE	7.0	7.0	7.0

6.3 Test Results:**SRD 900M:**

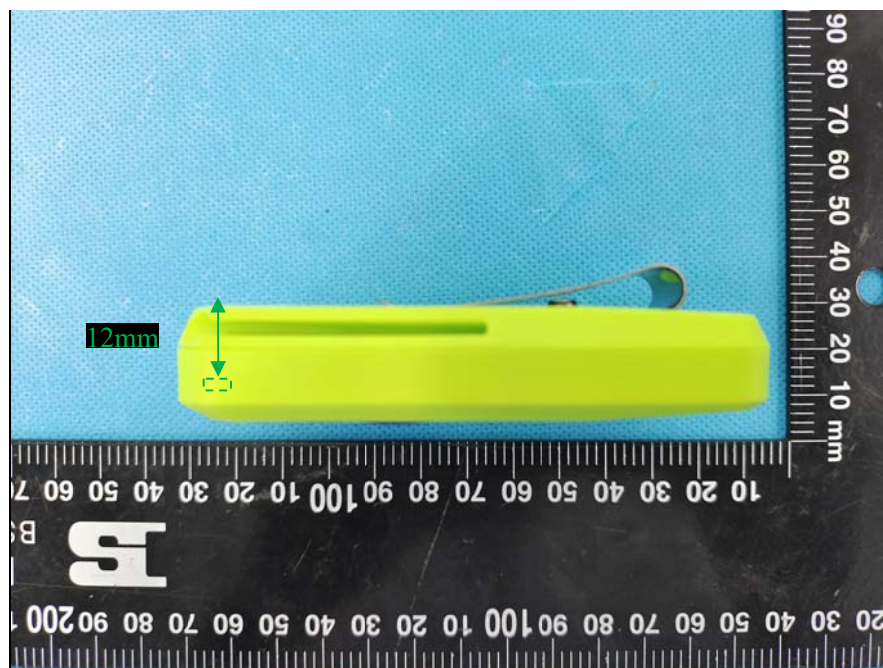
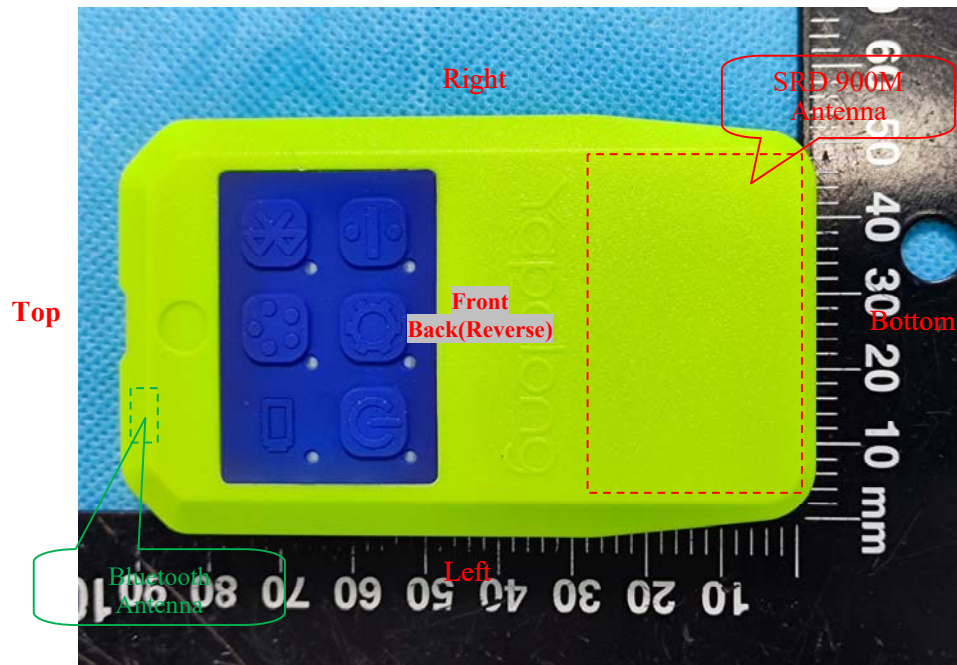
Mode	Channel frequency (MHz)	Duty Cycle (%)	Conducted Output Power(dBm)
SRD 900M	903.401	5.7	26.42
	915.401		26.29
	926.651		26.12

Bluetooth:

Mode	Channel frequency (MHz)	RF Output Power (dBm)
BDR(GFSK)	2402	9.74
	2441	9.67
	2480	9.84
EDR($\pi/4$ -DQPSK)	2402	9.65
	2441	9.59
	2480	9.71
EDR(8DPSK)	2402	9.68
	2441	9.77
	2480	9.81
BLE_1M	2402	6.02
	2440	6.68
	2480	6.96

7. Standalone SAR test exclusion considerations

Antennas Location:



7.1 Standalone SAR test exclusion considerations

Mode	Frequency (MHz)	Output Power (dBm)	Output Power (mW)	Distance (mm)	Calculated value	Threshold (1-g)	SAR Test Exclusion
Bluetooth	2480	10.0	10.0	12	1.3	3	YES

Note: The bluetooth based peak power for calculation.

NOTE:

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot$

$[\sqrt{f(\text{GHz})}] \leq 3.0$ for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where

1. $f(\text{GHz})$ is the RF channel transmit frequency in GHz.

2. Power and distance are rounded to the nearest mW and mm before calculation.

3. The result is rounded to one decimal place for comparison.

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

7.2 Standalone SAR estimation:

Mode	Frequency (MHz)	Output Power (dBm)	Output Power (mW)	Distance (mm)	Estimated 1-g (W/kg)
BT Body	2480	10.0	10.0	12	0.17

Note: The bluetooth based peak power for calculation.

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

$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot$
 $[\sqrt{f(\text{GHz})} / x]$

W/kg for test separation distances ≤ 50 mm;

where $x = 7.5$ for 1-g SAR.

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

8. SAR MEASUREMENT RESULTS

This page summarizes the results of the performed dosimetric evaluation.

8.1 SAR Test Data

Environmental Conditions

Temperature:	23.3-24.2 °C
Relative Humidity:	33 %
ATM Pressure:	100.4 kPa
Test Date:	2022/09/11

Testing was performed by Carl Chen, Ken Zong, Way Li.

SRD 900M:

EUT Position	Frequency (MHz)	Max. Meas. Power (dBm)	Max. Rated Power (dBm)	1g SAR (W/kg), Limit=1.6W/kg			
				Scaled Factor	Meas. SAR	Scaled SAR	Plot
Body Back (0mm)	903.401	26.42	26.5	1.019	0.238	0.24	1#
	915.401	26.29	26.5	1.05	0.26	0.27	2#
	926.651	26.12	26.5	1.091	0.241	0.26	3#

Note:

1. When the 1-g SAR is $\leq 0.8\text{W/kg}$, testing for other channels are optional.
2. When SAR or MPE is not measured at the maximum power level allowed for production units, the results must be scaled to the maximum tune-up tolerance limit according to the power applied to the individual channels tested to determine compliance.

9. SAR Measurement Variability

In accordance with published RF Exposure KDB procedure 865664 D01 SAR measurement 100 MHz to 6 GHz v01. These additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results

- 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 ($\sim 10\%$ 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 .

Note: 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.

The Highest Measured SAR Configuration in Each Frequency Band

Body

SAR probe calibration point	Frequency Band	Freq.(MHz)	EUT Position	Meas. SAR (W/kg)		Largest to Smallest SAR Ratio
				Original	Repeated	
/	/	/	/	/	/	/

Note:

1. Second Repeated Measurement is not required since the ratio of the largest to smallest SAR for the original and first repeated measurement is not > 1.20 .
2. The measured SAR results **do not** have to be scaled to the maximum tune-up tolerance to determine if repeated measurements are required.
3. 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.

10. SAR SIMULTANEOUS TRANSMISSION DESCRIPTION

Simultaneous Transmission:

Description of Simultaneous Transmit Capabilities		
Transmitter Combination	Simultaneous?	Hotspot?
SRD 900M + Bluetooth	√	×

Simultaneous SAR test exclusion considerations:

Mode(SAR1+SAR2)	Position	Reported SAR(W/kg)		Σ SAR < 1.6W/kg
		SAR1	SAR2	
SRD 900M + Bluetooth	Body Back	0.27	0.17	0.44

Conclusion:

Sum of SAR: Σ SAR \leq 1.6 W/kg therefore simultaneous transmission SAR with Volume Scans is **not required**.

11. SAR Plots

Plot 1#: SRD 900M Low_ Body Back

DUT: Yapalong; Type: Yapalong6000; Serial: CR22070055-SA-S1

Communication System: 900M SRD; Frequency: 903.401 MHz; Duty Cycle: 1:17.54

Medium parameters used: $f = 903.401$ MHz; $\sigma = 0.951$ S/m; $\epsilon_r = 41.693$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7522; ConvF(9.24, 9.24, 9.24) @ 903.401 MHz; Calibrated: 2022/5/6
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1325; Calibrated: 2022/8/29
- Phantom: SAM 1; Type: QD000P40CC; Serial: TP:1412
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7470)

Area Scan (61x81x1): Interpolated grid: $dx=1.500$ mm, $dy=1.500$ mm

Maximum value of SAR (interpolated) = 0.320 W/kg

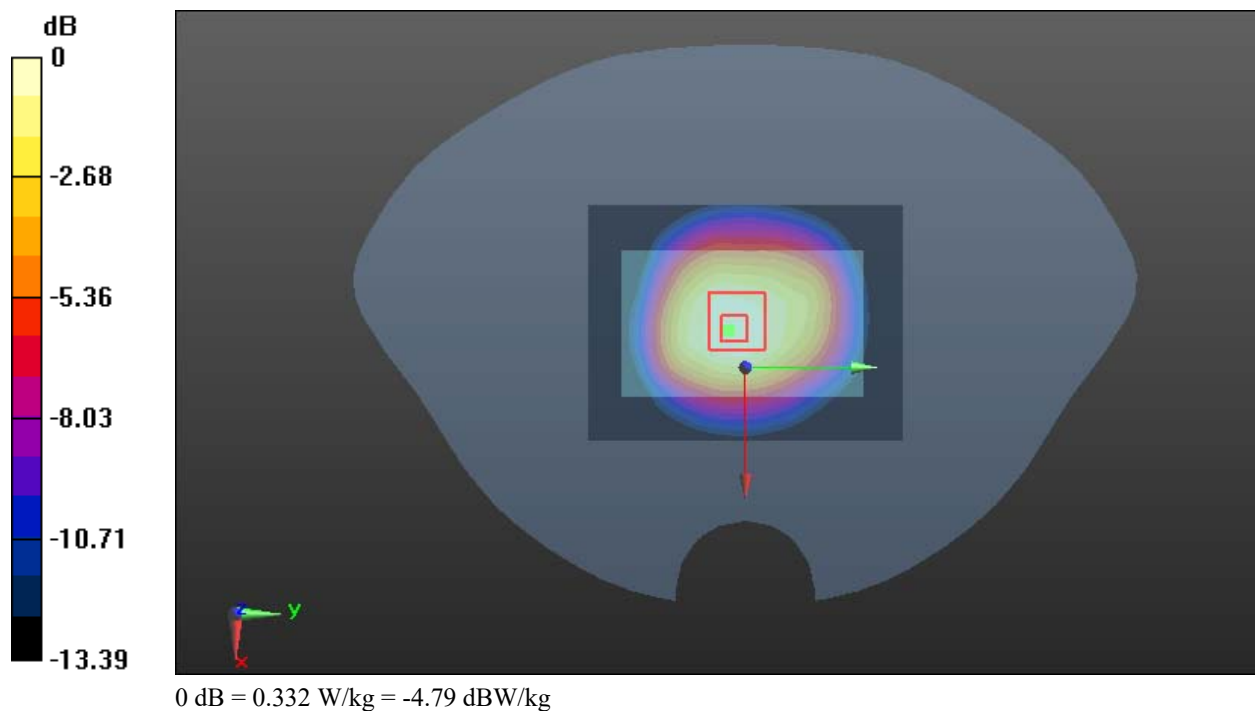
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8$ mm, $dy=8$ mm, $dz=5$ mm

Reference Value = 16.45 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 0.390 W/kg

SAR(1 g) = 0.238 W/kg; SAR(10 g) = 0.156 W/kg

Maximum value of SAR (measured) = 0.332 W/kg



Plot 2#: SRD 900M Mid_ Body Back**DUT: Yapalong; Type: Yapalong6000; Serial: CR22070055-SA-S1**

Communication System: 900M SRD; Frequency: 915.401 MHz; Duty Cycle: 1:17.54

Medium parameters used: $f = 915.401$ MHz; $\sigma = 0.972$ S/m; $\epsilon_r = 41.284$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7522; ConvF(9.24, 9.24, 9.24) @ 915.401 MHz; Calibrated: 2022/5/6
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1325; Calibrated: 2022/8/29
- Phantom: SAM 1; Type: QD000P40CC; Serial: TP:1412
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7470)

Area Scan (61x81x1): Interpolated grid: $dx=1.500$ mm, $dy=1.500$ mm

Maximum value of SAR (interpolated) = 0.342 W/kg

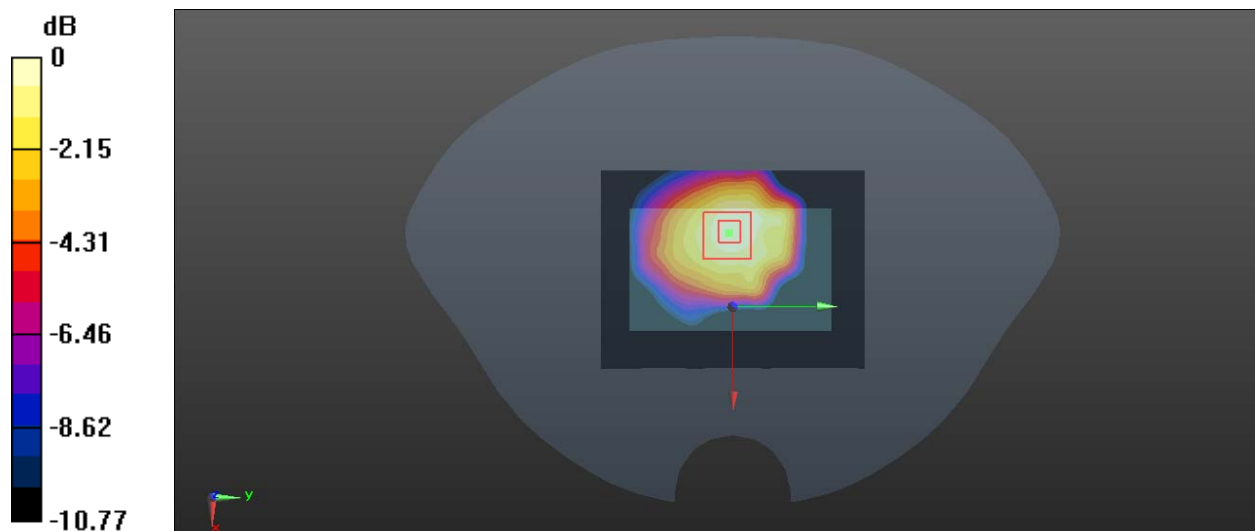
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8$ mm, $dy=8$ mm, $dz=5$ mm

Reference Value = 14.31 V/m; Power Drift = 0.12 dB

Peak SAR (extrapolated) = 0.426 W/kg

SAR(1 g) = 0.260 W/kg; SAR(10 g) = 0.170 W/kg

Maximum value of SAR (measured) = 0.354 W/kg



0 dB = 0.354 W/kg = -4.51 dBW/kg

Plot 3#: SRD 900M High_ Body Back**DUT: Yapalong; Type: Yapalong6000; Serial: CR22070055-SA-S1**

Communication System: 900M SRD; Frequency: 926.651 MHz; Duty Cycle: 1:17.54

Medium parameters used: $f = 926.651$ MHz; $\sigma = 0.996$ S/m; $\epsilon_r = 40.892$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7522; ConvF(9.24, 9.24, 9.24) @ 926.651 MHz; Calibrated: 2022/5/6
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1325; Calibrated: 2022/8/29
- Phantom: SAM 1; Type: QD000P40CC; Serial: TP:1412
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7470)

Area Scan (61x81x1): Interpolated grid: $dx=1.500$ mm, $dy=1.500$ mm

Maximum value of SAR (interpolated) = 0.324 W/kg

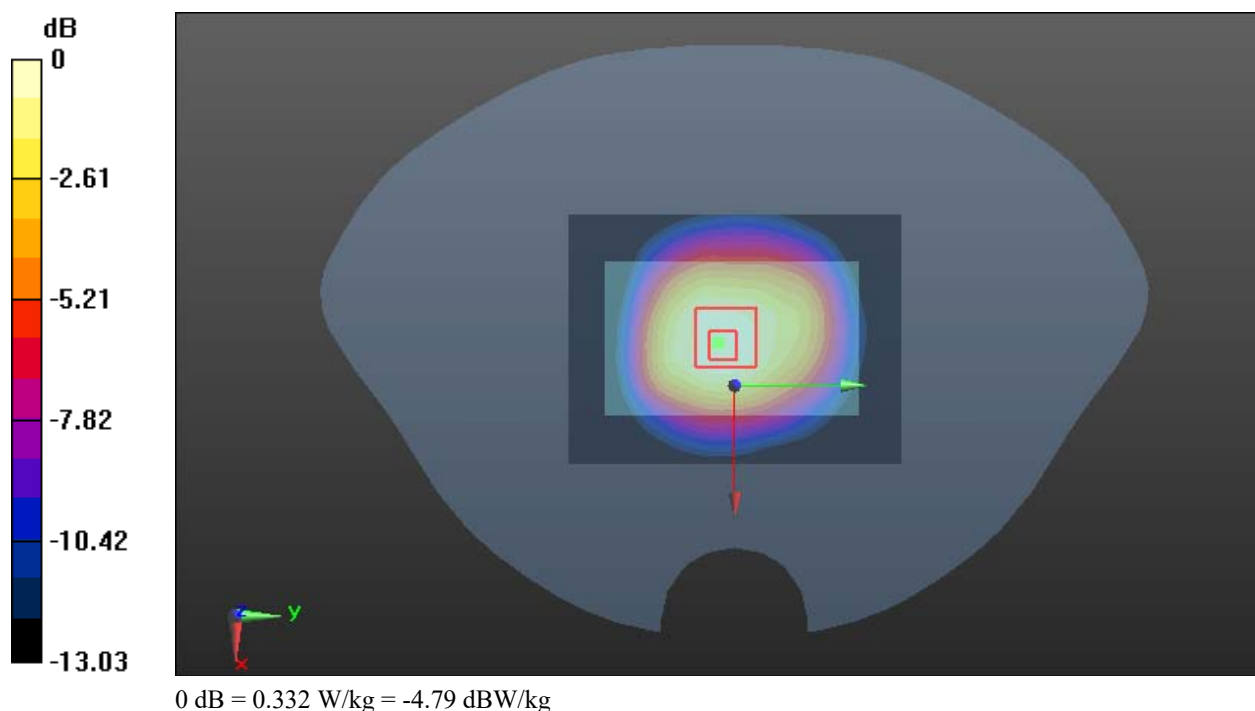
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8$ mm, $dy=8$ mm, $dz=5$ mm

Reference Value = 16.46 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 0.394 W/kg

SAR(1 g) = 0.241 W/kg; SAR(10 g) = 0.158 W/kg

Maximum value of SAR (measured) = 0.332 W/kg



APPENDIX A MEASUREMENT UNCERTAINTY

The uncertainty budget has been determined for the measurement system and is given in the following Table.

Measurement uncertainty evaluation for IEEE1528-2013 SAR test

Source of uncertainty	Tolerance/ uncertainty ± %	Probability distribution	Divisor	ci (1 g)	ci (10 g)	Standard uncertainty ± %, (1 g)	Standard uncertainty ± %, (10 g)
Measurement system							
Probe calibration	6.55	N	1	1	1	6.3	6.3
Axial Isotropy	4.7	R	$\sqrt{3}$	1	1	2.7	2.7
Hemispherical Isotropy	9.6	R	$\sqrt{3}$	0	0	0.0	0.0
Boundary effect	1.0	R	$\sqrt{3}$	1	1	0.6	0.6
Linearity	4.7	R	$\sqrt{3}$	1	1	2.7	2.7
Detection limits	1.0	R	$\sqrt{3}$	1	1	0.6	0.6
Readout electronics	0.3	N	1	1	1	0.3	0.3
Response time	0.0	R	$\sqrt{3}$	1	1	0.0	0.0
Integration time	0.0	R	$\sqrt{3}$	1	1	0.0	0.0
RF ambient conditions – noise	1.0	R	$\sqrt{3}$	1	1	0.6	0.6
RF ambient conditions– reflections	1.0	R	$\sqrt{3}$	1	1	0.6	0.6
Probe positioner mech. Restrictions	0.8	R	$\sqrt{3}$	1	1	0.5	0.5
Probe positioning with respect to phantom shell	6.7	R	$\sqrt{3}$	1	1	3.9	3.9
Post-processing	2.0	R	$\sqrt{3}$	1	1	1.2	1.2
Test sample related							
Test sample positioning	2.8	N	1	1	1	2.8	2.8
Device holder uncertainty	6.3	N	1	1	1	6.3	6.3
Drift of output power	5.0	R	$\sqrt{3}$	1	1	2.9	2.9
Phantom and set-up							
Phantom uncertainty (shape and thickness tolerances)	4.0	R	$\sqrt{3}$	1	1	2.3	2.3
Liquid conductivity target)	5.0	R	$\sqrt{3}$	0.64	0.43	1.8	1.2
Liquid conductivity meas.)	2.5	N	1	0.64	0.43	1.6	1.1
Liquid permittivity target)	5.0	R	$\sqrt{3}$	0.6	0.49	1.7	1.4
Liquid permittivity meas.)	2.5	N	1	0.6	0.49	1.5	1.2
Combined standard uncertainty		RSS				12.2	12.0
Expanded uncertainty 95 % confidence interval)						24.1	23.7

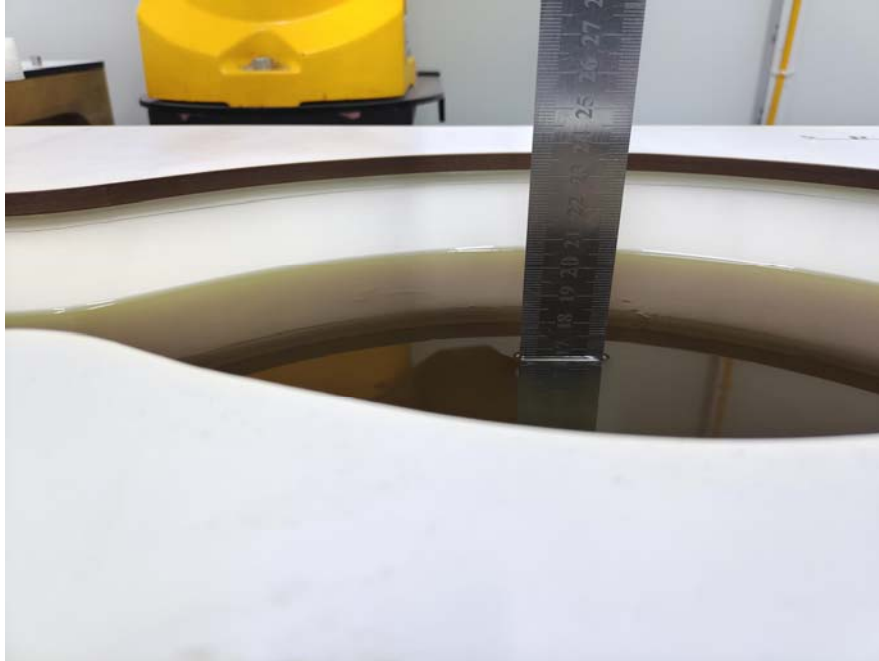
Measurement uncertainty evaluation for IEC62209-1 SAR test

Source of uncertainty	Tolerance/ uncertainty ± %	Probability distribution	Divisor	ci (1 g)	ci (10 g)	Standard uncertainty ± %, (1 g)	Standard uncertainty ± %, (10 g)
Measurement system							
Probe calibration	6.55	N	1	1	1	6.3	6.3
Axial Isotropy	4.7	R	$\sqrt{3}$	1	1	2.7	2.7
Hemispherical Isotropy	9.6	R	$\sqrt{3}$	0	0	0.0	0.0
Boundary effect	1.0	R	$\sqrt{3}$	1	1	0.6	0.6
Linearity	4.7	R	$\sqrt{3}$	1	1	2.7	2.7
Detection limits	1.0	R	$\sqrt{3}$	1	1	0.6	0.6
Readout electronics	0.3	N	1	1	1	0.3	0.3
Response time	0.0	R	$\sqrt{3}$	1	1	0.0	0.0
Integration time	0.0	R	$\sqrt{3}$	1	1	0.0	0.0
RF ambient conditions – noise	1.0	R	$\sqrt{3}$	1	1	0.6	0.6
Probe positioning with respect to phantom shell	6.7	R	$\sqrt{3}$	1	1	3.9	3.9
Probe positioner mech. Restrictions	0.8	R	$\sqrt{3}$	1	1	0.5	0.5
RF ambient conditions– reflections	1.0	R	$\sqrt{3}$	1	1	0.6	0.6
Post-processing	2.0	R	$\sqrt{3}$	1	1	1.2	1.2
Test sample related							
Test sample positioning	2.8	N	1	1	1	2.8	2.8
Device holder uncertainty	6.3	N	1	1	1	6.3	6.3
Drift of output power	5.0	R	$\sqrt{3}$	1	1	2.9	2.9
Phantom and set-up							
Phantom uncertainty (shape and thickness tolerances)	4.0	R	$\sqrt{3}$	1	1	2.3	2.3
Liquid conductivity target)	5.0	R	$\sqrt{3}$	0.64	0.43	1.8	1.2
Liquid conductivity meas.)	2.5	N	1	0.64	0.43	1.6	1.1
Liquid permittivity target)	5.0	R	$\sqrt{3}$	0.6	0.49	1.7	1.4
Liquid permittivity meas.)	2.5	N	1	0.6	0.49	1.5	1.2
Combined standard uncertainty		RSS				12.2	12.0
Expanded uncertainty 95 % confidence interval)						24.0	23.6

APPENDIX B EUT TEST POSITION PHOTOS

Liquid depth $\geq 15\text{cm}$

Phantom: Twin SAM; Type: Twin SAM V5.0; Serial: TP:1412



Body Back Setup Photo (0 mm)



APPENDIX C CALIBRATION CERTIFICATES



Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2117
E-mail: cttl@chinattl.com http://www.caict.ac.cn



中国认可
国际互认
校准
CALIBRATION
CNAS L0570

Client

BACL

Certificate No: Z22-60125

CALIBRATION CERTIFICATE

Object

EX3DV4 - SN : 7522

Calibration Procedure(s)

FF-Z11-004-02

Calibration Procedures for Dosimetric E-field Probes

Calibration date:

May 06, 2022

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	101919	15-Jun-21(CTTL, No.J21X04466)	Jun-22
Power sensor NRP-Z91	101547	15-Jun-21(CTTL, No.J21X04466)	Jun-22
Power sensor NRP-Z91	101548	15-Jun-21(CTTL, No.J21X04466)	Jun-22
Reference 10dBAttenuator	18N50W-10dB	20-Jan-21(CTTL, No.J21X00486)	Jan-23
Reference 20dBAttenuator	18N50W-20dB	20-Jan-21(CTTL, No.J21X00485)	Jan-23
Reference Probe EX3DV4	SN 7464	26-Jan-22(SPEAG, No.EX3-7464_Jan22)	Jan-23
DAE4	SN 1555	20-Aug-21(SPEAG, No.DAE4-1555_Aug21/2)	Aug-22
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
SignalGenerator MG3700A	6201052605	16-Jun-21(CTTL, No.J21X04467)	Jun-22
Network Analyzer E5071C	MY46110673	14-Jan-22(CTTL, No.J22X00406)	Jan-23

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

Issued: May 10, 2022

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

Certificate No: Z22-60125

Page 1 of 9



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CALIBRATION LABORATORY



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Glossary:

TSL	tissue simulating liquid
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,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 $\theta=0$ 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:

- 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"

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}:** Assessed for E-field polarization $\theta=0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not effect the E^2 -field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z} = NORM_{x,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.
- DCP_{x,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.
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; VR_{x,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 $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty valued are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy):** in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset:** The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle:** The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).



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DASY/EASY – Parameters of Probe: EX3DV4 – SN:7522

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.44	0.45	0.54	$\pm 10.0\%$
DCP(mV) ^B	99.7	100.6	98.6	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	150.4	$\pm 2.6\%$
		Y	0.0	0.0	1.0		152.9	
		Z	0.0	0.0	1.0		167.4	

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 4).

^B Numerical linearization parameter: uncertainty not required.

^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.



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DASY/EASY – Parameters of Probe: EX3DV4 – SN:7522

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	9.70	9.70	9.70	0.12	1.65	±12.1%
900	41.5	0.97	9.24	9.24	9.24	0.14	1.60	±12.1%
1750	40.1	1.37	8.10	8.10	8.10	0.28	0.98	±12.1%
1900	40.0	1.40	7.79	7.79	7.79	0.27	1.07	±12.1%
2300	39.5	1.67	7.50	7.50	7.50	0.49	0.80	±12.1%
2450	39.2	1.80	7.22	7.22	7.22	0.51	0.80	±12.1%
2600	39.0	1.96	7.02	7.02	7.02	0.57	0.76	±12.1%

^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 below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ±10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ±5%. 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.

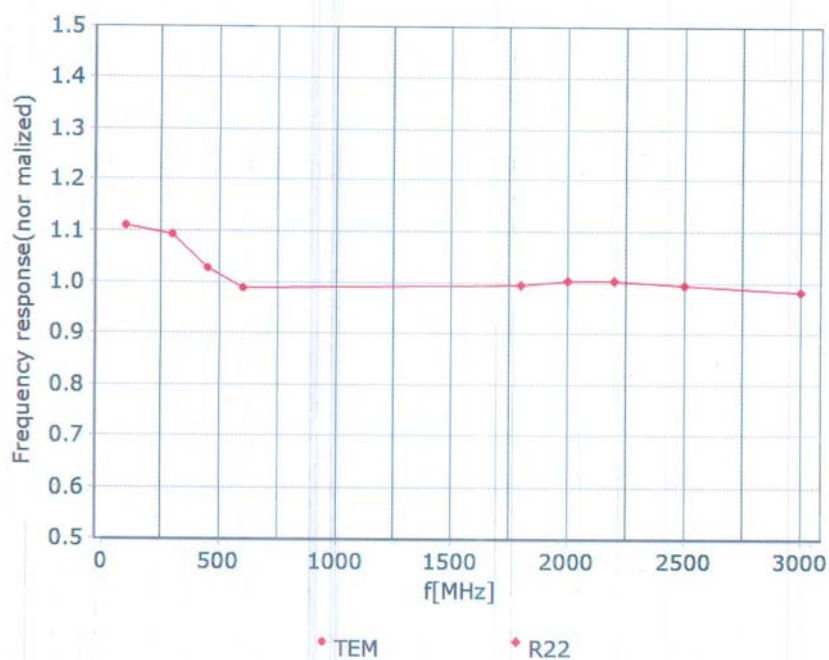


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Frequency Response of E-Field (TEM-Cell: ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field: $\pm 7.4\%$ ($k=2$)

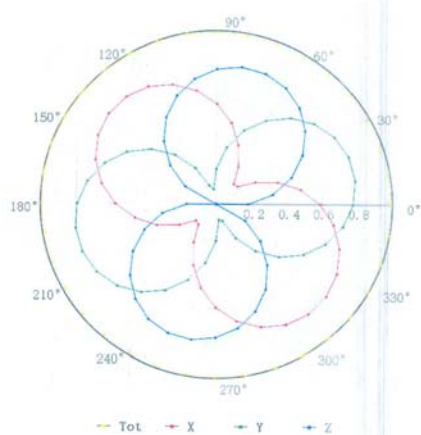


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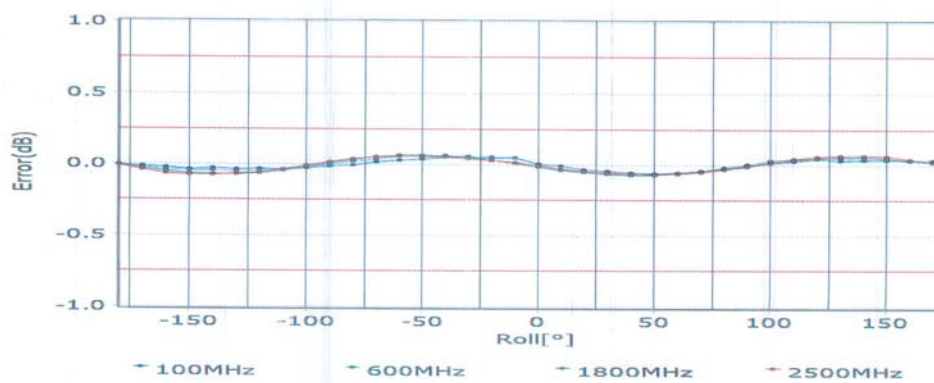
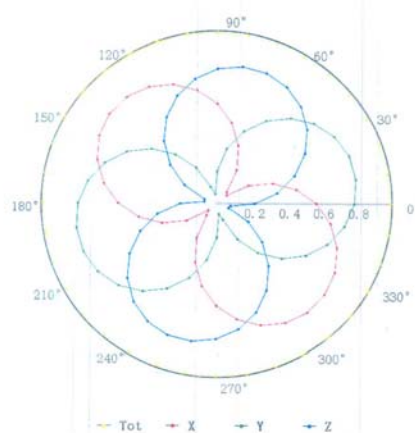


Receiving Pattern (Φ), $\theta=0^\circ$

f=600 MHz, TEM



f=1800 MHz, R22



Uncertainty of Axial Isotropy Assessment: $\pm 1.2\%$ ($k=2$)

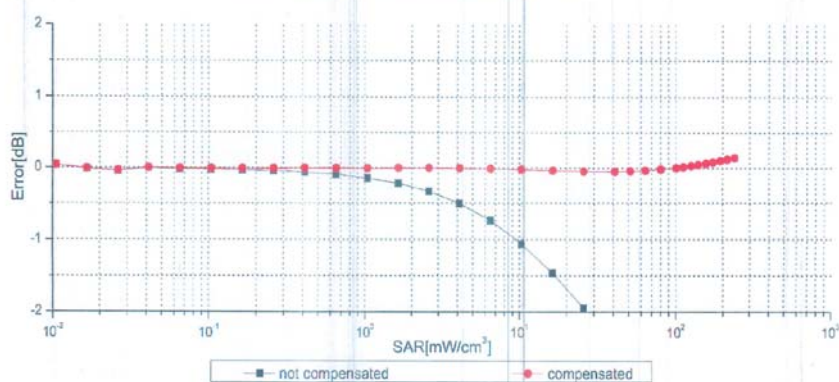
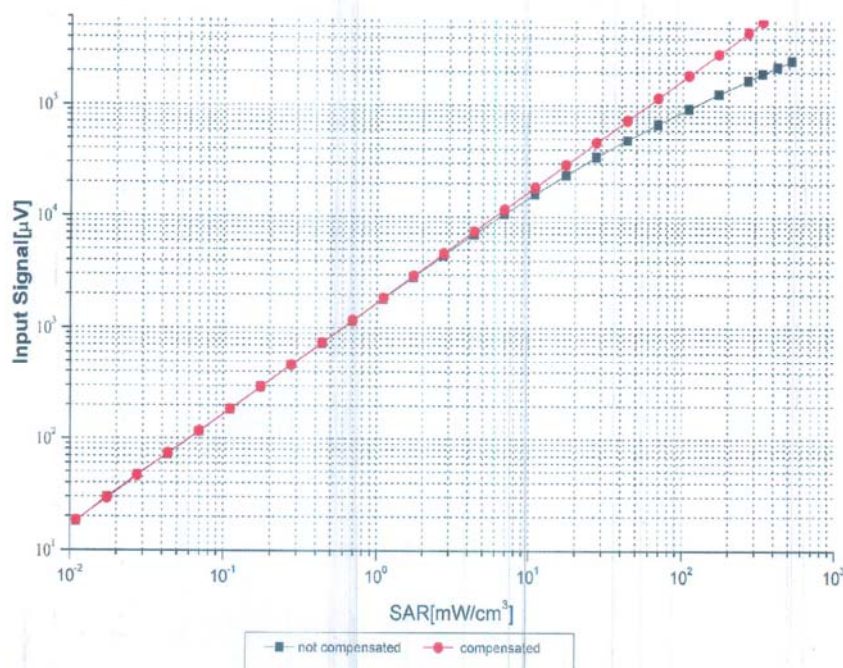


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Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell, $f = 900 \text{ MHz}$)



Uncertainty of Linearity Assessment: $\pm 0.9\%$ ($k=2$)

Certificate No: Z22-60125

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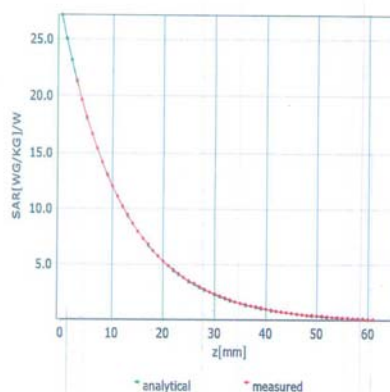
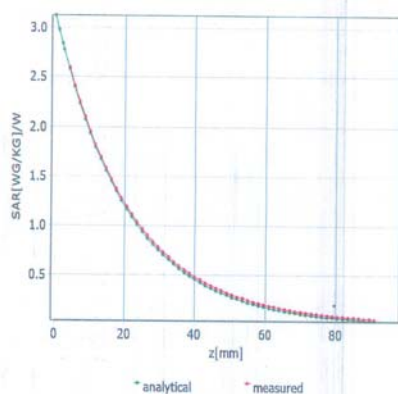
<http://www.caict.ac.cn>



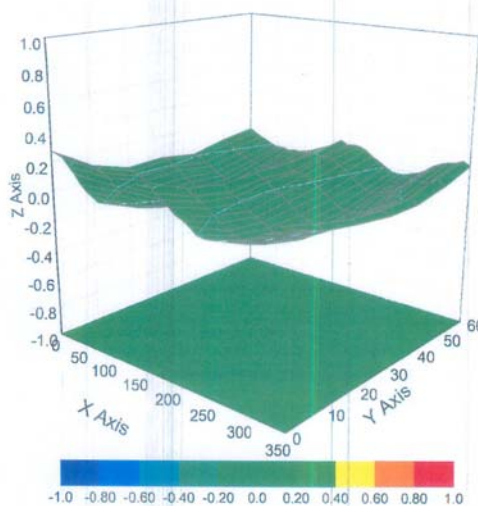
Conversion Factor Assessment

$f=750\text{ MHz, WGLS R9(H_convF)}$

$f=1750\text{ MHz, WGLS R22(H_convF)}$



Deviation from Isotropy in Liquid



Uncertainty of Spherical Isotropy Assessment: $\pm 3.2\%$ ($k=2$)



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DASY/EASY – Parameters of Probe: EX3DV4 – SN:7522

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	30.7
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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Client

BACL

Certificate No: Z21-60315

CALIBRATION CERTIFICATE

Object

D900V2 - SN:1d183

Calibration Procedure(s)

FF-Z11-003-01

Calibration Procedures for dipole validation kits

Calibration date:

August 27, 2021

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	23-Sep-20 (CTTL, No.J20X08336)	Sep-21
Power sensor NRP8S	104291	23-Sep-20 (CTTL, No.J20X08336)	Sep-21
Reference Probe EX3DV4	SN 7517	03-Feb-21(CTTL-SPEAG,No.Z21-60001)	Feb-22
DAE3	SN 536	06-Nov-20(CTTL-SPEAG,No.Z20-60452)	Nov-21
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	01-Feb-21 (CTTL, No.J21X00593)	Jan-22
NetworkAnalyzer E5071C	MY46110673	14-Jan-21 (CTTL, No.J21X00232)	Jan-22

	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: August 31, 2021

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

Certificate No: Z21-60315

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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", February 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%.



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Measurement Conditions

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

DASY Version	DASY52	52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	900 MHz \pm 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.97 mho/m
Measured Head TSL parameters	(22.0 \pm 0.2) °C	41.2 \pm 6 %	0.96 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	2.70 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	10.9 W/kg \pm 18.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.73 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.96 W/kg \pm 18.7 % (k=2)



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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.9Ω- 0.87jΩ
Return Loss	- 33.8dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.318 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
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DASY5 Validation Report for Head TSL

Date: 08.27.2021

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 900 MHz; Type: D900V2; Serial: D900V2 - SN: 1d183

Communication System: UID 0, CW; Frequency: 900 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 900$ MHz; $\sigma = 0.96$ S/m; $\epsilon_r = 41.22$; $\rho = 1000$ kg/m³

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7517; ConvF(9.4, 9.4, 9.4) @ 900 MHz; Calibrated: 2021-02-03
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn536; Calibrated: 2020-11-06
- Phantom: MFP_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

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

Reference Value = 60.56 V/m; Power Drift = -0.01 dB

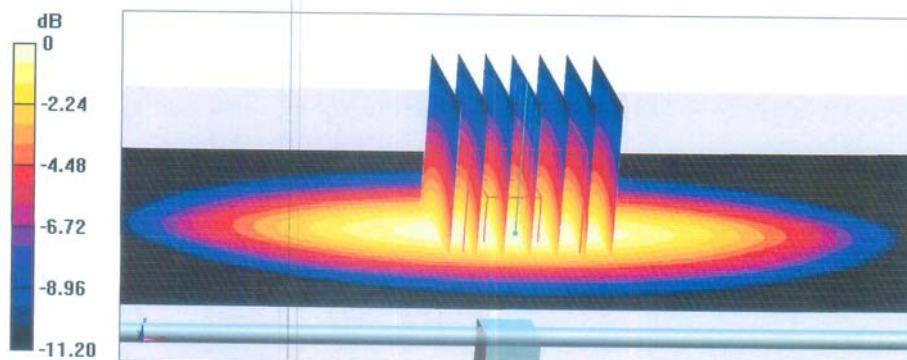
Peak SAR (extrapolated) = 4.29 W/kg

SAR(1 g) = 2.7 W/kg; SAR(10 g) = 1.73 W/kg

Smallest distance from peaks to all points 3 dB below = 17.5 mm

Ratio of SAR at M2 to SAR at M1 = 63.2%

Maximum value of SAR (measured) = 3.71 W/kg



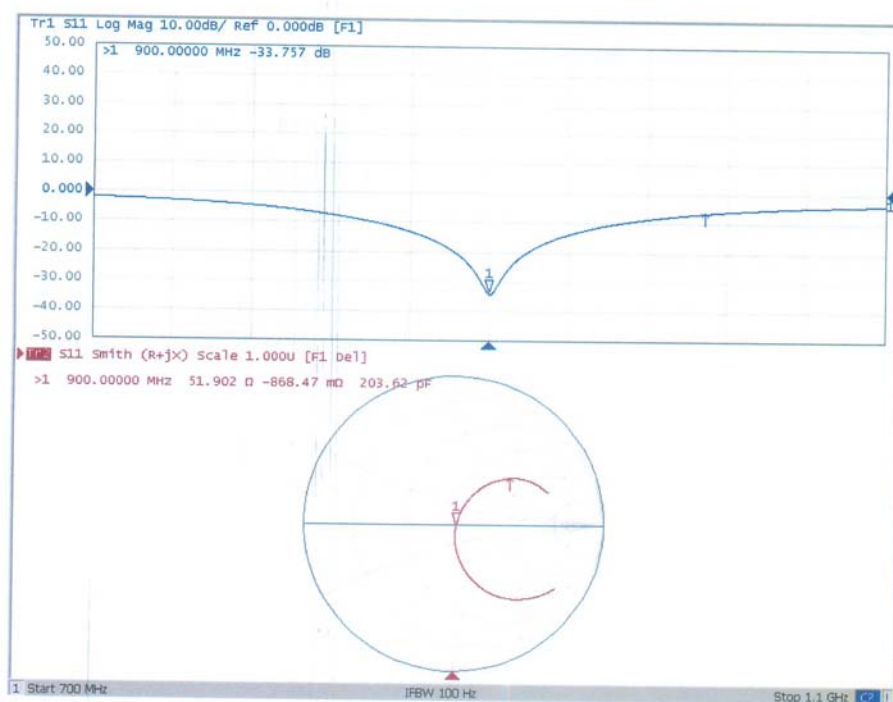
0 dB = 3.71 W/kg = 5.69 dBW/kg



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Impedance Measurement Plot for Head TSL



******* END OF REPORT *******