Prüfbericht – Produkte
Test Report - Products

Prüfbericht-Nr.: *Test report no.:*	**ULR-TC568820300000019F**	**Auftrags-Nr.:** *Order no.:*	166232885 0030	Seite 1 von 34 *Page 1 of 34*
Kunden-Referenz-Nr.: *Client reference no.:*	NA	**Auftragsdatum:** *Order date:*	2020-02-10	
Auftraggeber: *Client:*	Adyton LLC 550 LOCKPORT RD Rochester Hills 48307 Michigan United states			
Prüfgegenstand: *Test item:*	Pythia			
Bezeichnung / Serien -Nr.: *Identification / Serial no.:*	PY-M1.0-0001 PY-M1.0-0002			
Auftrags-Inhalt: *Order content:*	Testing & issue of test report and FCC Grant Certificate			
Prüfgrundlage: *Test specification:*	FCC 47 CFR Part 2 subpart 2.1093 IEEE Std 1528-2013 KDB 447498 D01 / KDB 248227 D01			
Wareneingangsdatum: *Date of sample receipt:*	2020-02-17			
Prüfmuster-Nr.: *Test sample no:*	A001064342-001 A001064342-002			
Prüfzeitraum: *Testing period:*	2020-05-18 - 2020-05-19			
Ort der Prüfung: *Place of testing:*	Wireless laboratory, Bangalore			
Prüflaboratorium: *Testing laboratory:*	TÜV Rheinland (India) Pvt. Ltd. 27/B,2nd Cross, Electronic City Phase I, Bangalore – 560100, India			
Prüfergebnis*: *Test result*:*	Pass			

geprüft von: *tested by:*		**genehmigt von:** *authorized by:*	
Datum: *Date:* 2020-05-19		**Ausstellatum:** *Issue date:* 10.06.2020	
Stellung / *Position:*	**Rajesh M Gowda** Engineer	**Stellung** / *Position:*	**Mahammadgouse Kaladagi** Assistant Manager
Sonstiges / *Other:*	FCC ID :2AVV5-PF24V1		
Zustand des Prüfgegenstandes bei Anlieferung: *Condition of the test item at delivery:*		**Prüfmuster vollständig und unbeschädigt** ***Test item complete and undamaged***	

* Legende:	1 = sehr gut	2 = gut	3 = befriedigend	4 = ausreichend	5 = mangelhaft
	P(ass) = entspricht o.g. Prüfgrundlage(n)		F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	N/A = nicht anwendbar	N/T = nicht getestet
** Legend:*	*1 = very good*	*2 = good*	*3 = satisfactory*	*4 = sufficient*	*5 = poor*
	P(ass) = passed a.m. test specification(s)		*F(ail) = failed a.m. test specification(s)*	*N/A = not applicable*	*N/T = not tested*

Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens.
This test report only relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.

V05

TEST SUMMARY

Mode	Band	Body/head	Adjusted SAR Value (1g) W/kg	Adjusted SAR Value (10g) W/kg	Limit 1g (W/kg)	Limit 10g (W/kg)	Result
Wi-Fi IEEE 802.11 (b/g/n)	2.4 GHz	Body	0.101	0.033	1.6	2.0	PASS
		Head	0.069	0.019	1.6	2.0	PASS

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg) specified in FCC 47 CFR Subpart 2.1093 and ANSI/IEEE C95.1-1999. Testing is performed with measurement methods and procedures specified in IEEE 1528-2013 and FCC KDB publications

Note: This product contains Wi-Fi 2.4 GHz and Bluetooth module since client is not using Bluetooth module it is completely disabled.

Discipline: Electronics Testing
Group: EMC Test Facility

REVISION HISTORY OF THIS REPORT

Report Number	Version	Description	Issue date
ULR-TC568820300000019F	01	Initial issue of report	10.06.2020

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1 GENERAL REMARKS

1.1 Attachments

All the attachments are integral part of this test report

1. TEST SETUP PHOTOS
2. APPENDIX A: PLOTS FOR SAR MEASUREMENT
3. APPENDIX B: PLOTS FOR SYSTEM VERIFICATION
4. APPENDIX C: CALIBRATION CERTIFICATE FOR PROBE AND DIPOLE

2 TEST SITES

2.1 Testing Facilities

TUV Rheinland (India) Private Limited
27/B, 2nd Cross Road,
Electronic City Phase 1,
Bangalore – 560 100.
India

2.2 List of Test and Measurement Instruments

Table 1: Test and measurement instruments used

Equipment	Manufacturer	Model Name	Serial Number	Firmware Versions	Calibration Due Date	Periodicity	Test Facility
System Validation Dipole	Schmid & Partner Engineering AG	D2450V2	902	-	10.02.2021	Yearly	System Performance Check
Power Sensor	Agilent	E4412A	MY50360055	-	22.05.2020	Yearly	
Power Meter	Agilent	N1913A	MY50000459	A1.01.15	22.05.2020	Yearly	
USB Peak Power Sensor	AIMIL Ltd	55006	10231	3.0.12.0	09.01.2021	Yearly	
RF and microwave Signal Generator	Rohde & Schwarz	SMB100A	108788	3.01.203.32	30.12.2020	Yearly	
Isotropic E-Field	Schmid & Partner Engineering AG	EX3DV4	7374	-	28.10.2020	Yearly	SAR Measurement
Data Acquisition Electronics	Schmid & Partner Engineering AG	DAE4	640	-	11.10.2020	Yearly	
SAR Chamber	Lindgren RF Enclosures	-	-	-	-	-	
DAK-3.5	Schmid & Partner Engineering AG	SMDAK 040 CA	1100	-	13.02.2021	Yearly	Liquid Validation
Network Analyzer	Rohde & Schwarz	ZVL-6	102433	3.32	15.02.2021	Yearly	

Table 2: Instrument application Software versions

Sl. No	Test Type	Application software	Version
1	SAR Measurement	cDSY6	6.10

3 GENERAL PRODUCT INFORMATION

3.1 Product Function and Intended Use

Pythia is designed for mobile workflow learning, performance assurance, and performance improvement in environments where people work with their hands and can't efficiently or safely use cell phone, printed text, computers, or most other performance support and workflow learning aids. Users will verbally request processes, listen to an instruction, perform the instruction, and continue listening & performing steps until the process is completed. The data collected is intended to reveal performance, process, organizational, and other continuous improvement opportunities for businesses.

3.2 Ratings and System Details of Equipment under Test

Table 3: Ratings and System Details as declared by client*

Radio Protocol		Wi-Fi
Frequency Range		2412MHz to 2462MHz
No. of channel		11 (Refer Table 5)
Channel Spacing		5MHz
Maximum Measured Power (e.i.r.p)		16.34 dBm (1Mbps 2462MHz)
Transmitted Power settings		802.11n, MCS7 mode : +14dBm maximum 802.11b Mode: +20dBm maximum 802.11g Mode: +16dBm Maximum
Modulation		802.11b: DSSS (CSK) 802.11g/n: OFDM (BPSK/QPSK/16QAM/64QAM)
Number of antenna		1
Antenna Gain and Type		2.0 dBi and PCB Antenna
Supply Voltage		5 VDC USB Charging, 3.0 VDC to 4.2 VDC Battery Input
Dimensions		95 x 34 x 17 mm (L x W x H)
Environmental Condition	**Operating**	-10°C to +70°C temperature, Relative Humidity < 70 %
	Storage	0°C to +50°C temperature, Relative Humidity < 60 %

***Disclaimer:**
The information/data is supplied by the clinet and the same is considered to arrive at the final value.
Any changes made apart from the specified specification, can directly impact on the tests results. Refer the products user manual for more details.

3.1 Measurement Uncertainty:

Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of *k* = 2

Table 4: Measurement Uncertainty

Worst-Case uncertainty budget for DASY6 assessed according to IEEE 1528, IEC 62209-1 & IEC 62209-2. The budget is valid for the frequency range 300MHz - 6GHz and represents a worst-case analysis. For specific tests and configurations, the uncertainty could be considerably smaller.							
Error Description	**Uncert. Value**	**Prob. Dist.**	**Div.**	**(ci) 1g**	**(ci) 10g**	**Std. Unc. (1g)**	**Std. Unc. (10g)**
Measurement System							
Probe Calibration	6.30%	N	2	1	1	3.2%	3.2%
Axial Isotropy	4.70%	R	SQRT(3)	0.7	0.7	1.9%	1.9%
Hemispherical Isotropy	9.60%	R	SQRT(3)	0.7	0.7	3.9%	3.9%
Boundary Effects	2.00%	R	SQRT(3)	1	1	1.2%	1.2%
Linearity	4.70%	R	SQRT(3)	1	1	2.7%	2.7%
System Detection Limits	1.00%	R	SQRT(3)	1	1	0.6%	0.6%
Modulation Response	2.40%	R	SQRT(3)	1	1	1.4%	1.4%
Readout Electronics	0.30%	N	1	1	1	0.3%	0.3%
Response Time	0.80%	R	SQRT(3)	1	1	0.5%	0.5%
Integration Time	2.60%	R	SQRT(3)	1	1	1.5%	1.5%
RF Ambient Noise	3.00%	R	SQRT(3)	1	1	1.7%	1.7%
RF Ambient Reflections	3.00%	R	SQRT(3)	1	1	1.7%	1.7%
Probe Positioner mechanical tolerance	0.04%	R	SQRT(3)	1	1	0.0%	0.0%
Probe Positioning with respect to phantom shell	0.80%	R	SQRT(3)	1	1	0.5%	0.5%
Max. SAR Eval.	4.00%	R	SQRT(3)	1	1	2.3%	2.3%
Test Sample Related							
Device Positioning	2.90%	N	1	1	1	2.9%	2.9%
Device Holder	3.60%	N	1	1	1	3.6%	3.6%
Power Drift	5.00%	R	SQRT(3)	1	1	2.9%	2.9%
Power Scaling	0%	R	SQRT(3)	1	1	0.0%	0.0%
Phantom and Setup							
Phantom Uncertainty	7.60%	R	SQRT(3)	1	1	4.4%	4.4%
SAR correction	1.90%	N	1	1	0.84	1.9%	1.6%
Liquid Conductivity (mea.)DAK	2.50%	N	1	0.78	0.71	2.0%	1.8%
Liquid Permittivity (mea.) DAK	2.50%	N	1	0.23	0.26	0.6%	0.7%
Temp. unc. - Conductivity	3.40%	R	SQRT(3)	0.78	0.71	1.5%	1.4%
Temp. unc. - Permittivity	0.40%	R	SQRT(3)	0.23	0.26	0.1%	0.1%
Combined Std. Uncertainty						10.6%	10.5%
Expanded STD Uncertainty						**21.2%**	**21.0%**

Note: The listed uncertainties are the worst case uncertainties for the entire range of measurements and are for the reporting purpose only and are not used in determining the PASS/FAIL of the results.

4 TEST SET-UP AND OPERATION MODE

4.1 Principle of Configuration Selection

Transmission was enabled with continuous transmission on low, middle and high channels.

4.2 Test Operation and Test Software

Test software was used to enable the continuous transmission, changing channels (low/mid/high) and data rates on the EUT for the tests in this report.

Software Version of Pythia Earphone: ESP RFTool_2.3.exe

APP Software Version: ESP32_RF_TEST_BIN_V1.5.0_20190812.bin

Hardware version - Hardware Version: Pythai_V1

4.3 Special Accessories and Auxiliary Equipment

- None

4.4 Countermeasures to achieve EMC Compliance

- None

4.5 List of Frequencies and Frequency bands

Frequency Band (MHz)	Channel No.	Channel Frequency (MHz)
2400 – 2483.5	1	**2412**
	2	2417
	3	2422
	4	2427
	5	2432
	6	**2437**
	7	2442
	8	2447
	9	2452
	10	2457
	11	**2462**

Table 5: List of Wi-Fi center Frequencies

Protocol: Wi-Fi:

Channel Bandwidth: 20MHz

Channel low: 2412MHz

Channel mid: 2437MHz

Channel High: 2462MHz

Note:

TUV Sample Identification number:	Conducted sample	-	A001064342-002
	Radiated & SAR test Sample	-	A001064342-001

4.6 Report references

Note: Product Pythia has multiple protocols. All the supported wireless protocols and their respective test results are issued in saparate test reports, following table lists the report numbers.

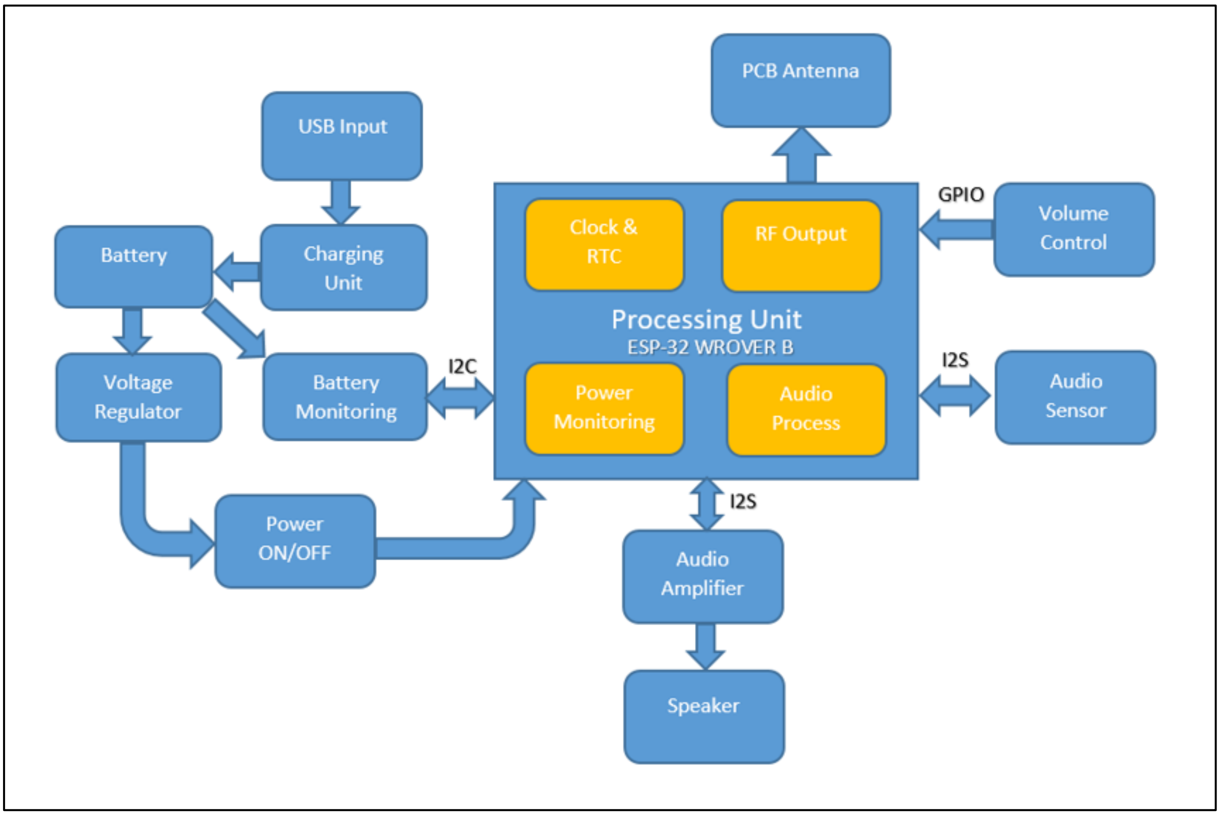
Radio Protocol	Report Number
RF test report for Wi-Fi (2.4GHz) & BLE (2.4GHz)	ULR-TC568820300000018F
SAR test report for Wi-Fi (2.4 GHz) – (This report)	ULR-TC568820300000019F

5 Operational Description of the product

Pythia is a mobile workflow learning and mobile performance assurance system. It verbally delivers step-by-step work instructions on demand and captures worker performance at process step granularity, via cloud database records and a conversational and/or mechanical interface to an 802.11n Wi-Fi earphone.

Operating Pythia requires a cloud database record, a Pythia Wi-Fi earphone, and an 802.11n Wi-Fi network. Upon powering up the earphone, the earphone automatically connects to a pre-configured Wi-Fi network, users verbally request a standard operating procedure (SOP) by title, the request is passed to the cloud, and the record is found. After finding the record, the system consecutively converts text fields to speech, plays them on-the-fly to the earphone, and tracks how long it takes users to advance through each step. Users navigate the system using a verbal wake word, verbal commands, or by pressing a button on the earphone.

6 Block Diagram of the product



7 TEST METHODOLOGY

The Specific Absorption Rate (SAR) measurement specifications, methods, and procedures for this device are in accordance with the following standards:

- IEEE 1528-2013 — IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques
- FCC KDB 447498 D01 — General RF Exposure Guidance v06
- FCC KDB 248227 D01 — 802.11 Wi-Fi SAR v02r02
- FCC KDB 865664 D01 — SAR Measurement 100 MHz to 6 GHz v01r04
- FCC KDB 865664 D02 — RF Exposure Reporting v01r02

8 Statement of Compliance

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg) specified in FCC 47 CFR Subpart 2.1093 and ANSI/IEEE C95.1-1999. Testing is performed with measurement methods and procedures specified in IEEE 1528-2013 and FCC KDB publications

9 RF Exposure Limits

9.1 Uncontrolled Environment

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

9.2 Controlled Environment

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

Guideline /Standard	**Limits for Occupational/ Controlled Exposure**		**Limits for General Population/ Uncontrolled Exposure**	
	Head, trunk, arms, legs (W/kg)	**Hands, wrists, feet and ankles (W/kg)**	**Head, trunk, arms, legs (W/kg)**	**Hands, wrists, feet and ankles (W/kg)**
ANSI/IEEE C95.1-1999	8 (1g)	20 (10g)	1.6 (1g)	4 (10g)

10 SAR Measurement System

10.1 Definition of Specific Absorption Rate (SAR)

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 modelling. 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.

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 related to the electrical field in the tissue by

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

Where: σ is the conductivity of the tissue,

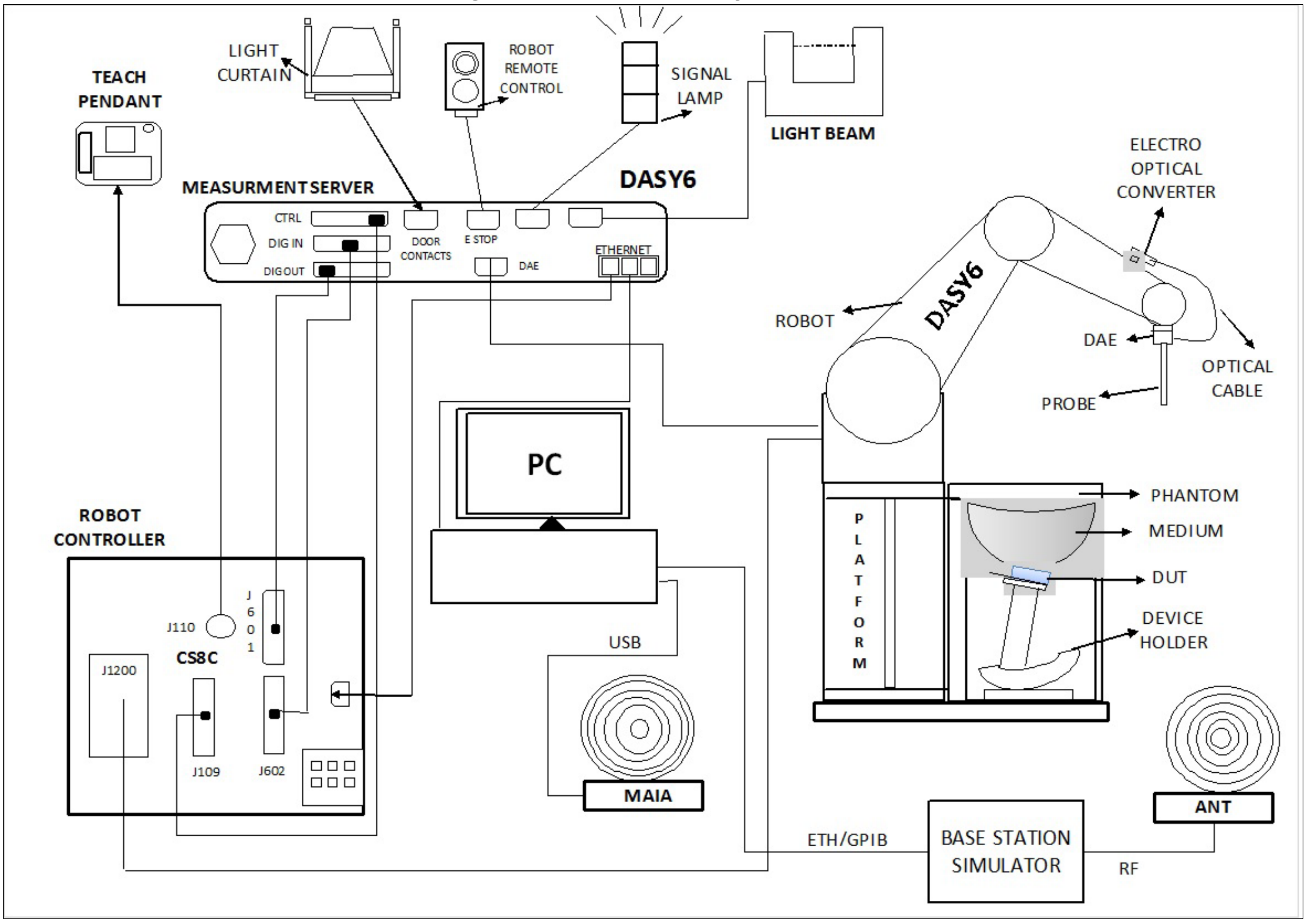
ρ is the mass density of the tissue

E is the RMS electrical field strength.

10.2 SPEAG DASY System

DASY system consists of high precision robot, probe alignment sensor, phantom, robot controller, controlled measurement server and near-field probe. The robot includes six axes that can move to the precision position of the DASY6 software defined. The DASY software can define the area that is detected by the probe. The robot is connected to controlled box. Controlled measurement server is connected to the controlled robot box. The DAE includes amplifier, signal multiplexing, AD converter, offset measurement and surface detection. It is connected to the Electro-optical coupler (ECO). The ECO performs the conversion form the optical into digital electric signal of the DAE and transfers data to the PC.

Figure 1: SPEAG DASY6 System



Robot

The DASY system uses the high precision robots from Stäubli SA (France). For the 6-axis controller system, the robot controller version (DASY6: CS8c) from Stäubli is used. The Stäubli robot series have many features that are important for our application:

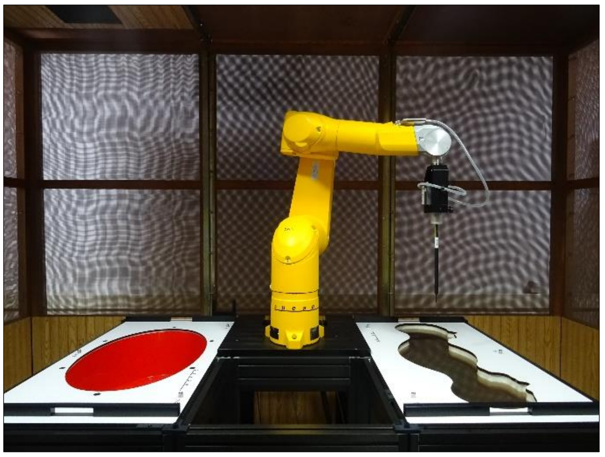
· High precision (repeatability ±0.02 mm)

· High reliability (industrial design)

· Jerk-free straight movements(brushless synchron motors, no stepper motors)

· Low ELF interference (motor control fields are shielded by the closed metallic construction)

Figure 2: SPEAG DASY6 Robot



Probes

The SAR measurement is conducted with the dosimetric probe. The probe is specially designed and calibrated for use in liquid with high permittivity. The dosimetric probe has special calibration in liquid at different frequency.

Model	EX3DV4
Construction	Symmetrical design with triangular core. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., DGBE).
Frequency	4 MHz – 10 GHz Linearity: ±0.2 dB (30 MHz – 10 GHz)
Directivity	±0.1 dB in TSL (rotation around probe axis) ±0.3 dB in TSL (rotation normal to probe axis)
Dynamic Range	10 μW/g – >100 mW/g Linearity: ±0.2 dB (noise: typically <1 μW/g)
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm

Figure 3: EX3DV4 Probe

Data Acquisition Electronics (DAE)

Model	DAE4
Construction	Signal amplifier, multiplexer, A/D converter and control logic. Serial optical link for communication with DASY embedded system (fully remote controlled). Two step probe touch detector for mechanical surface detection and emergency robot stop.
Measurement Range	-100 to +300 mV (16 bit resolution and two range settings: 4mV, 400mV)
Input Offset Voltage	< 5µV (with auto zero)
Input Bias Current	< 50 fA
Dimensions	60 x 60 x 68 mm

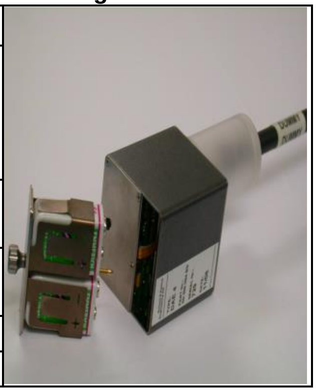


Figure 4: DAE4

Phantoms

Model	Twin SAM
Construction	The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528 and IEC 62209-1. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by teaching three points with the robot.
Material	Vinylester, glass fiber reinforced (VE-GF)
Shell Thickness	2 ± 0.2 mm (6 ± 0.2 mm at ear point)
Dimensions	Length: 1000 mm Width: 500 mm Height: adjustable feet
Filling Volume	approx. 25 liters

Figure 5: Twin SAM Phantom

Model	ELI
Construction	Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI is fully compatible with the IEC 62209-2 standard and all known tissue simulating liquids. ELI has been optimized regarding its performance and can be integrated into our standard phantom tables. A cover prevents evaporation of the liquid. Reference markings on the phantom allow installation of the complete setup, including all predefined phantom positions and measurement grids, by teaching three points. The phantom is compatible with all SPEAG dosimetric probes and dipoles.
Material	Vinylester, glass fiber reinforced (VE-GF)
Shell Thickness	2.0 ± 0.2 mm (bottom plate)
Dimensions	Major axis: 600 mm Minor axis: 400 mm
Filling Volume	approx. 30 liters

Figure 6: ELI Phantom

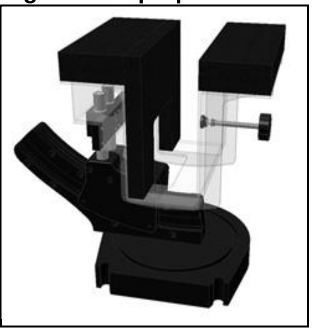
Device Holder

Figure 7: Mounting Device

Model	Mounting Device
Construction	In combination with the Twin SAM Phantom or ELI4, the Mounting Device enables the rotation of the mounted transmitter device in spherical coordinates. Rotation point is the ear opening point. Transmitter devices can be easily and accurately positioned according to IEC 62209-1, IEEE 1528, FCC or other specifications. The device holder can be locked for positioning at different phantom sections (left head, right head, flat).
Material	POM

Figure 8: Laptop Extension

Model	Laptop Extensions Kit
Construction	Simple but effective and easy-to-use extension for Mounting Device that facilitates the testing of larger devices according to IEC 62209-2 (e.g., laptops, cameras, etc.). It is lightweight and fits easily on the upper part of the Mounting Device in place of the phone positioner.
Material	POM, Acrylic glass, Foam



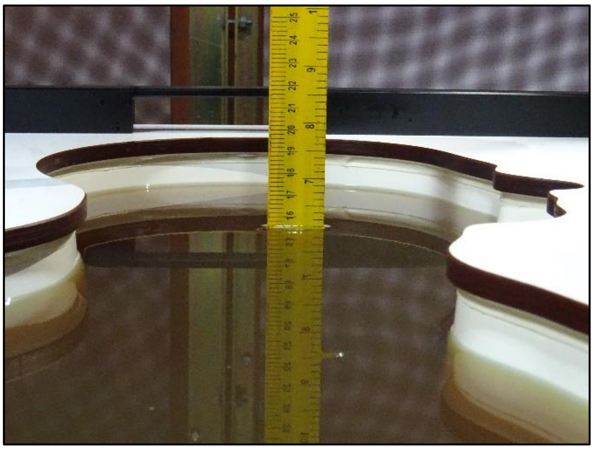
System Validation Dipoles

Figure 9: D-Serial Dipole

Model	D-Serial
Construction	Symmetrical dipole with λ/4 balun. Enables measurement of feed point impedance with NWA. Matched for use near flat phantoms filled with tissue simulating solutions.
Frequency	750 MHz to 5800 MHz
Return Loss	> 20 dB
Power Capability	> 100 W (f < 1GHz), > 40 W (f > 1GHz)

Tissue Simulating Liquids

For SAR measurement of the field distribution inside the phantom, the phantom must be filled with homogeneous tissue simulating liquid to a depth of at least 15 cm. For head SAR testing, the liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15 cm. For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm. The nominal dielectric values of the tissue simulating liquids in the phantom and the tolerance of 5% are listed.



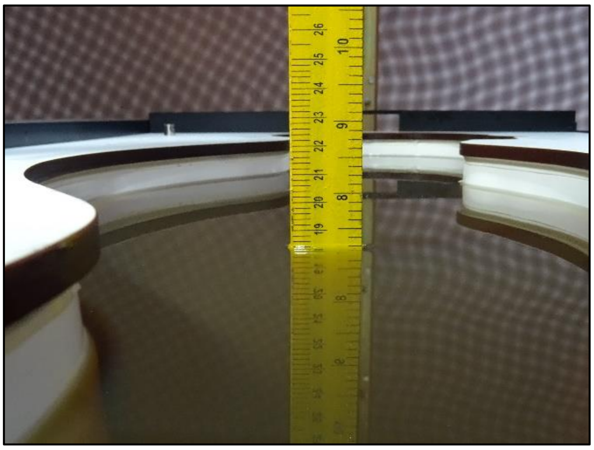


Figure 10: Photo of Liquid Height for Head Position & Photo of Liquid Height for Body Position

The dielectric properties of the head tissue simulating liquids are defined in IEEE 1528, and KDB 865664 D01 Appendix A. For the body tissue simulating liquids, the dielectric properties are defined in KDB 865664 D01 Appendix A. The dielectric properties of the tissue simulating liquids were verified prior to the SAR evaluation using a dielectric assessment kit(DAK) and a network analyzer.

Table 6: Targets of Tissue Simulating Liquid

Frequency (MHz)	Target Permittivity	Range of ±5%	Target Conductivity	Range of ±5%
For Head				
750	41.9	39.8 ~ 44.0	0.89	0.85 ~ 0.93
835	41.5	39.4 ~ 43.6	0.90	0.86 ~ 0.95
900	41.5	39.4 ~ 43.6	0.97	0.92 ~ 1.02
1450	40.5	38.5 ~ 42.5	1.20	1.14 ~ 1.26
1640	40.3	38.3 ~ 42.3	1.29	1.23 ~ 1.35
1750	40.1	38.1 ~ 42.1	1.37	1.30 ~ 1.44
1800	40.0	38.0 ~ 42.0	1.40	1.33 ~ 1.47
1900	40.0	38.0 ~ 42.0	1.40	1.33 ~ 1.47
2000	40.0	38.0 ~ 42.0	1.40	1.33 ~ 1.47
2300	39.5	37.5 ~ 41.5	1.67	1.59 ~ 1.75
2450	39.2	37.2 ~ 41.2	1.80	1.71 ~ 1.89
2600	39.0	37.1 ~ 41.0	1.96	1.86 ~ 2.06
3500	37.9	36.0 ~ 39.8	2.91	2.76 ~ 3.06
5200	36.0	34.2 ~ 37.8	4.66	4.43 ~ 4.89
5300	35.9	34.1 ~ 37.7	4.76	4.52 ~ 5.00
5500	35.6	33.8 ~ 37.4	4.96	4.71 ~ 5.21
5600	35.5	33.7 ~ 37.3	5.07	4.82 ~ 5.32
5800	35.3	33.5 ~ 37.1	5.27	5.01 ~ 5.53
For Body				
750	55.5	52.7 ~ 58.3	0.96	0.91 ~ 1.01
835	55.2	52.4 ~ 58.0	0.97	0.92 ~ 1.02
900	55.0	52.3 ~ 57.8	1.05	1.00 ~ 1.10
1450	54.0	51.3 ~ 56.7	1.30	1.24 ~ 1.37
1640	53.8	51.1 ~ 56.5	1.40	1.33 ~ 1.47
1750	53.4	50.7 ~ 56.1	1.49	1.42 ~ 1.56
1800	53.3	50.6 ~ 56.0	1.52	1.44 ~ 1.60
1900	53.3	50.6 ~ 56.0	1.52	1.44 ~ 1.60
2000	53.3	50.6 ~ 56.0	1.52	1.44 ~ 1.60
2300	52.9	50.3 ~ 55.5	1.81	1.72 ~ 1.90
2450	52.7	50.1 ~ 55.3	1.95	1.85 ~ 2.05
2600	52.5	49.9 ~ 55.1	2.16	2.05 ~ 2.27
3500	51.3	48.7 ~ 53.9	3.31	3.14 ~ 3.48
5200	49.0	46.6 ~ 51.5	5.30	5.04 ~ 5.57
5300	48.9	46.5 ~ 51.3	5.42	5.15 ~ 5.69
5500	48.6	46.2 ~ 51.0	5.65	5.37 ~ 5.93
5600	48.5	46.1 ~ 50.9	5.77	5.48 ~ 6.06
5800	48.2	45.8 ~ 50.6	6.00	5.70 ~ 6.30

The following table gives the recipes for tissue simulating liquids.

Table 7: Recipes of Tissue Simulating Liquid

Tissue Type	Bactericide	DGBE	HEC	NaCl	Sucrose	Triton X-100	Water	Diethylene Glycol Mono-hexylether
H750	0.2	-	0.2	1.5	56.0	-	42.1	-
H835	0.2	-	0.2	1.5	57.0	-	41.1	-
H900	0.2	-	0.2	1.4	58.0	-	40.2	-
H1450	-	43.3	-	0.6	-	-	56.1	-
H1640	-	45.8	-	0.5	-	-	53.7	-
H1750	-	47.0	-	0.4	-	-	52.6	-
H1800	-	44.5	-	0.3	-	-	55.2	-
H1900	-	44.5	-	0.2	-	-	55.3	-
H2000	-	44.5	-	0.1	-	-	55.4	-
H2300	-	44.9	-	0.1	-	-	55.0	-
H2450	-	45.0	-	0.1	-	-	54.9	-
H2600	-	45.1	-	0.1	-	-	54.8	-
H3500	-	8.0	-	0.2	-	20.0	71.8	-
H5G	-	-	-	-	-	17.2	65.5	17.3
B750	0.2	-	0.2	0.8	48.8	-	50.0	-
B835	0.2	-	0.2	0.9	48.5	-	50.2	-
B900	0.2	-	0.2	0.9	48.2	-	50.5	-
B1450	-	34.0	-	0.3	-	-	65.7	-
B1640	-	32.5	-	0.3	-	-	67.2	-
B1750	-	31.0	-	0.2	-	-	68.8	-
B1800	-	29.5	-	0.4	-	-	70.1	-
B1900	-	29.5	-	0.3	-	-	70.2	-
B2000	-	30.0	-	0.2	-	-	69.8	-
B2300	-	31.0	-	0.1	-	-	68.9	-
B2450	-	31.4	-	0.1	-	-	68.5	-
B2600	-	31.8	-	0.1	-	-	68.1	-
B3500	-	28.8	-	0.1	-	-	71.1	-
B5G	-	-	-	-	-	10.7	78.6	10.7

SAR System Verification

The system check verifies that the system operates within its specifications. It is performed daily or before every SAR measurement. The system check uses normal SAR measurements in the flat section of the phantom with a matched dipole at a specified distance. The system verification setup is shown as below.

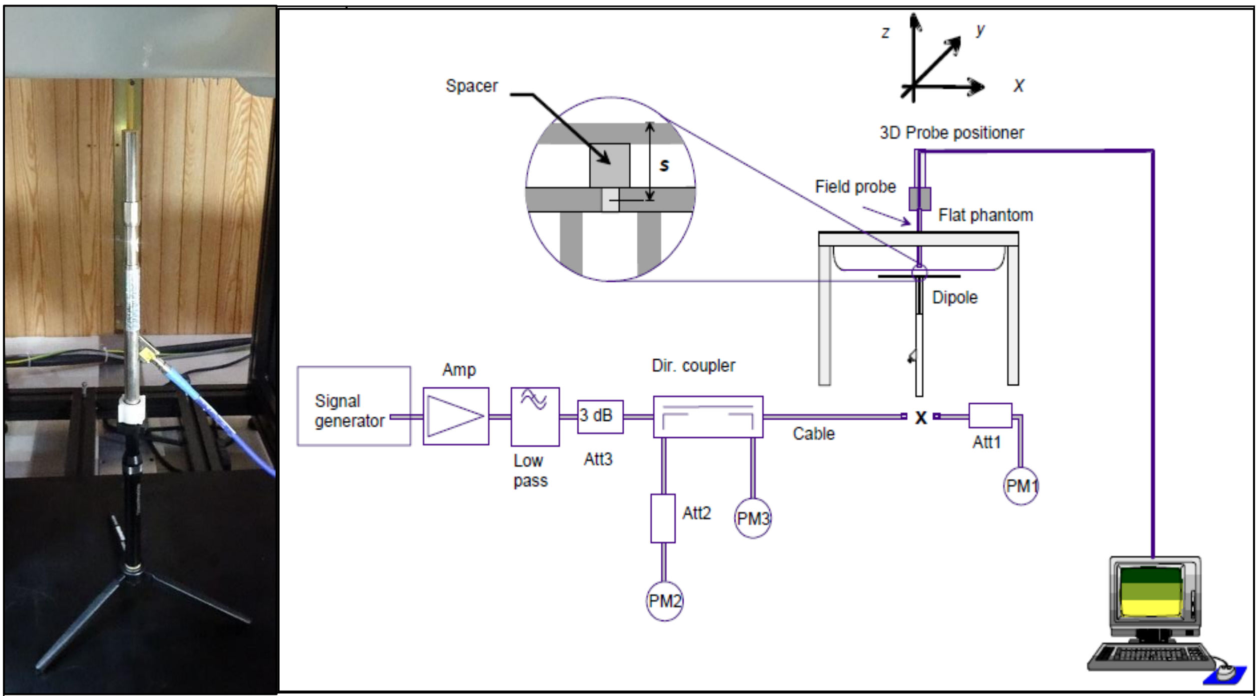


Figure 11: System Verification Setup

The validation dipole is placed beneath the flat phantom with the specific spacer in place. The distance spacer is touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom. The spectrum analyzer measures the forward power at the location of the system check dipole connector. The signal generator is adjusted for the desired forward power (250 mW is used for 700 MHz to 3 GHz, 100 mW is used for 3.5 GHz to 6 GHz) at the dipole connector and the power meter is read at that level. After connecting the cable to the dipole, the signal generator is readjusted for the same reading at power meter.

After system check testing, the SAR result will be normalized to 1W forward input power and compared with the reference SAR value derived from validation dipole certificate report. The deviation of system check should be within 10 %.

11 SAR Measurement Procedure

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

(a) Power reference measurement

(b) Area scan

(c) Zoom scan

(d) Power drift measurement

The SAR measurement procedures for each of test conditions are as follows:

(a) Make EUT to transmit maximum output power

(b) Measure conducted output power through RF cable

(c) Place the EUT in the specific position of phantom

(d) Perform SAR testing steps on the DASY system

(e) Record the SAR value

11.1 Area & Zoom Scan Procedure

First Area Scan is used to locate the approximate location(s) of the local peak SAR value(s). The measurement grid within an Area Scan is defined by the grid extent, grid step size and grid offset. Next, in order to determine the EM field distribution in a three-dimensional spatial extension, Zoom Scan is required. The Zoom Scan is performed around the highest E-field value to determine the averaged SAR-distribution over 10 g. According to KDB 865664 D01, the resolution for Area and Zoom scan is specified in the table below.

Items	<= 2 GHz	2-3 GHz	3-4 GHz	4-5 GHz	5-6 GHz
Area Scan (Δx, Δy)	<= 15 mm	<= 12 mm	<= 12 mm	<= 10 mm	<= 10 mm
Zoom Scan (Δx, Δy)	<= 8 mm	<= 5 mm	<= 5 mm	<= 4 mm	<= 4 mm
Zoom Scan (Δz)	<= 5 mm	<= 5 mm	<= 4 mm	<= 3 mm	<= 2 mm
Zoom Scan Volume	>= 30 mm	>= 30 mm	>= 28 mm	>= 25 mm	>= 22 mm

Note:

When zoom scan is required and report SAR is <= 1.4 W/kg, the zoom scan resolution of Δx / Δy (2-3GHz: <= 8 mm, 3-4GHz: <= 7 mm, 4-6GHz: <= 5 mm) may be applied.

11.2 Volume Scan Procedure

Volume Scans are 3D scans used to assess the peak spatial SAR values within an averaging volume containing 1g and 10g of simulated tissue. It is compatible with any phantom. For regular phantoms, the measurement grid is generated by projecting a plane onto the phantom surface as for Area and Zoom scans. For specific phantoms, the measurement grid is generated by a conformal offset to the phantom surface at the desired distances. The grid extents can be set by the end user to cover the DUT dimensions or the whole measurable area of the phantom.

11.3 Power Drift Monitoring

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

11.4 Spatial Peak SAR Evaluation

The procedure for spatial peak SAR evaluation has been implemented according to the IEEE 1528 standard. It can be conducted for 1 g and 10 g, as well as for user-specific masses. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

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

In DASY5 V5.2 SAR, the calculation is performed in the SEMCAD post processing engine. In cDASY6 Module SAR, the 1 g and 10 g cubes are calculated in the software itself.

11.5 SAR Averaged Methods

In DASY, the interpolation and extrapolation are both based on the modified Quadratic Shepard's method. The interpolation scheme combines a least-square fitted function method and a weighted average method which are the two basic types of computational interpolation and approximation.

Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. The uncertainty increases with the extrapolation distance. To keep the uncertainty within 1% for the 1 g and 10 g cubes, the extrapolation distance should not be larger than 5 mm.

11.6 Tissue Verification

Table 8: The measuring results for tissue simulating liquid

Tissue Type	Frequency (MHz)	Liquid Temp. (℃)	Measured Conductivity (σ)	Measured Permittivity (ε_r)	Target Conductivity (σ)	Target Permittivity (ε_r)	Conductivity Deviation (%)	Permittivity Deviation (%)	Test Date
H2450	2450	19.80	1.8	39.7	1.80	39.2	1.30	2.3	May. 18, 2020

Note:

1. The dielectric properties of the tissue simulating liquid must be measured within 24 hours before the SAR testing and within ±5% of the target values. Liquid temperature during the SAR testing must be within ±2°C.
2. Since the maximum deviation of dielectric properties of the tissue simulating liquid is within 5%, SAR correction is evaluated in the measurement uncertainty shown on section 3.1 of this report.

11.7 System Verification

Table 9: The measuring results for system check

Frequency (MHz)	TSL	Power [dBm]	Deviation 1g [%]	Deviation 10g [%]	Deviation Peak [%]	Isotropic Error [%]	Test Date
2450	HSL	17	4.5	2.4	9.0	-2.5	May.18, 2020

Note:

Comparing to the reference SAR value provided by SPEAG, the validation data should be within its specification of 10 %. The result indicates the system check can meet the variation criterion and the plots can be referred to APPENDIX B: PLOTS FOR SYSTEM VERIFICATION of this report.

11.8 RF Conducted Power

The measuring conducted power (Unit: dBm) are shown as below.

Table 10: The results of conducted power (Wi-Fi 2.4GHz)

Mode	Data rate (Mbps)	Channel Frequency (MHz)	Average Power (dBm)	Tune up tolerance (dB)	Average Power Including Tune-up Tolerance (dBm)	SAR Test applicability (Yes/No)**
b	1	2412	15.75	1	16.75	Yes
		2437	16.00	1	17.00	
		2462	16.34	1	17.34	
	11	2412	15.87	1	16.87	No
		2437	15.97	1	16.97	
		2462	16.31	1	17.31	
g	6	2412	14.69	1	15.69	No
		2437	15.01	1	16.01	
		2462	15.28	1	16.28	
	24	2412	13.5	1	14.50	No
		2437	13.31	1	14.31	
		2462	13.72	1	14.72	
	54	2412	11.39	1	12.39	No
		2437	11.22	1	12.22	
		2462	11.59	1	12.59	
n_HT20	MCS0	2412	15.16	1	16.16	No
		2437	15.24	1	16.24	
		2462	15.55	1	16.55	
	MCS4	2412	12.38	1	13.38	No
		2437	12.40	1	13.40	
		2462	13.10	1	14.10	
	MCS7	2412	9.47	1	10.47	No
		2437	9.67	1	10.67	
		2462	10.26	1	11.26	

Notes : SAR test reduction was applied from KDB 248227

** YES : SAR testing is performed, Refer clause 11.11 Guidelines Applied of this report

NO : SAR testing is excluded, Refer clause 11.11 Guidelines Applied of this report

*****Reffer clause 11.9 SAR Test Exclusion of this test report

11.9 SAR Test Exclusion

Based on the conducted power measurement, reported under section " RF Conducted Power " of this test report and derivation of Low-Power exclusion level defined in FCC KDBs 447498 D01 General RF Exposure Guidance v06 (See 4.3 a), SAR test exclusion was identified for the followong frequency band

RF protocol	Measured Frequency (MHz)	Maximum measured RF output power at antenna terminal (dBm)	Tune-up tolerance (dB)	Max power Including tune-up tolerance * (mW)	Exclusion threshold ** for separation distance of < 5 mm	SAR Test required (Yes/No)
Wi-Fi	2462	16.34 dBm	±1	54.20	17.008	Yes

***Max power is rounded to two decimal place for reporting
****separation distance of < 5 mm is used for the calculation

Hence RF exposure evaluation or SAR testig is required for Wi-Fi 2.4 GHz frequency range

- Per KDB 447498 D01v06, the 1-g and 10-g SAR Test Exclusion threshold for 100MHz to 6GHz at separation distance ≤5 mm are determined by
- The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm, and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm according to 4.1 f) is applied to determine SAR test exclusion.

[(*max. power of channel, including tune-up tolerance, mW*) / (*min. test separation distance, mm*)] · [$\sqrt{f_{(GHz)}}$] ≤ 3.0 for 1-g SAR, and ≤ 7.5 for 10-g extremity SAR

Where

f (GHz) is the RF channel transmit frequency in GHz

11.10 Simultaneous Transmission

This device do not support Simultaneous transmission. Hence SAR testing is not addressed for Simultaneous transansmission

11.11 Guidelines Applied

FCC KDB 248227 D01 802.11 Wi-Fi SAR v02r02

- The maximum output power specified for production units, including tune-up tolerance, are used to determine initial SAR test requirements for the 802.11 transmission modes in a frequency band.
- SAR test reduction is determined according to 802.11 transmission mode and configuration with multiple positons
- When the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel in the initial test configuration, for each frequency band
- The reported SAR must be scaled to the maximum transmission duty factor to determine compliance
- During SAR testing, RF transmission and EUT fuctionality is verified with spectrum analyzer

FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04

- Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg
- When the original highest measured SAR is ≥ 0.80 W/kg, repeat that measurement once
- 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).
- 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.

447498 D01 General RF Exposure Guidance v06

- Measured SAR is adjusted for maximum tune-up tolerance
- The test separation distances required for a device to demonstrate SAR or MPE compliance must be sufficiently conservative to support the operational separation distances required by the device and its antennas and radiating structures
- For SAR testing of WLAN signal with duty cycle <100%, the measured SAR is scalled-up by the duty cycle scalling factor (i.e. 1/duty cycle)
- For all the applicable exposure position, testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR of the mid-channel or highest output power channel is
    - ≤0.8 W/kg or ≤2 W/kg, for 1-g or 10-g respectively, when transmission band is ≤100MHz
    - ≤0.6 W/kg or ≤1.5 W/kg, for 1-g or 10-g respectively, when transmission band is between 100MHz and 200 MHz
    - ≤0.4 W/kg or ≤1 W/kg, for 1-g or 10-g respectively, when transmission band is ≥200MHz

11.12 SAR Testing Results

Table 11: SAR Testing Results(Wi-Fi 2.4 GHz)

Phantom	Position	Description	Channel	Frequency (MHz)	Measured SAR 1g [W/Kg]	Measured SAR 10g [W/Kg]	Tune-up tolerance (dB)	Adjusted SAR 1g [W/Kg]	Adjusted SAR 10g [W/Kg]
Flat HSL	FRONT	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	1	2412	0.063	0.02	±1	0.079	0.025
Flat HSL	FRONT	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	6	2437	0.064	0.02	±1	0.080	0.025
Flat HSL	FRONT	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	11	2462	0.081	0.026	±1	0.101	0.033

Phantom	Position	Description	Channel	Frequency (MHz)	Measured SAR 1g [W/Kg]	Measured SAR 10g [W/Kg]	Tune-up tolerance (dB)	Adjusted SAR 1g [W/Kg]	Adjusted SAR 10g [W/Kg]
Right Head HSL	CHEEK	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	1	2412	0.014	0.005	±1	0.018	0.006
Left Head HSL	CHEEK	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	1	2412	0.04	0.011	±1	0.050	0.014
Right Head HSL	CHEEK	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	6	2437	0.014	0.004	±1	0.018	0.005
Left Head HSL	CHEEK	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	6	2437	0.043	0.011	±1	0.054	0.014

Right Head HSL	CHEEK	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	11	2462	0.016	0.005	±1	0.020	0.006
Left Head HSL	CHEEK	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	11	2462	0.055	0.015	±1	0.069	0.019

12 TEST SETUP PHOTOS

Photo 1 : EUT kept in Cheek position with the Right head phantom

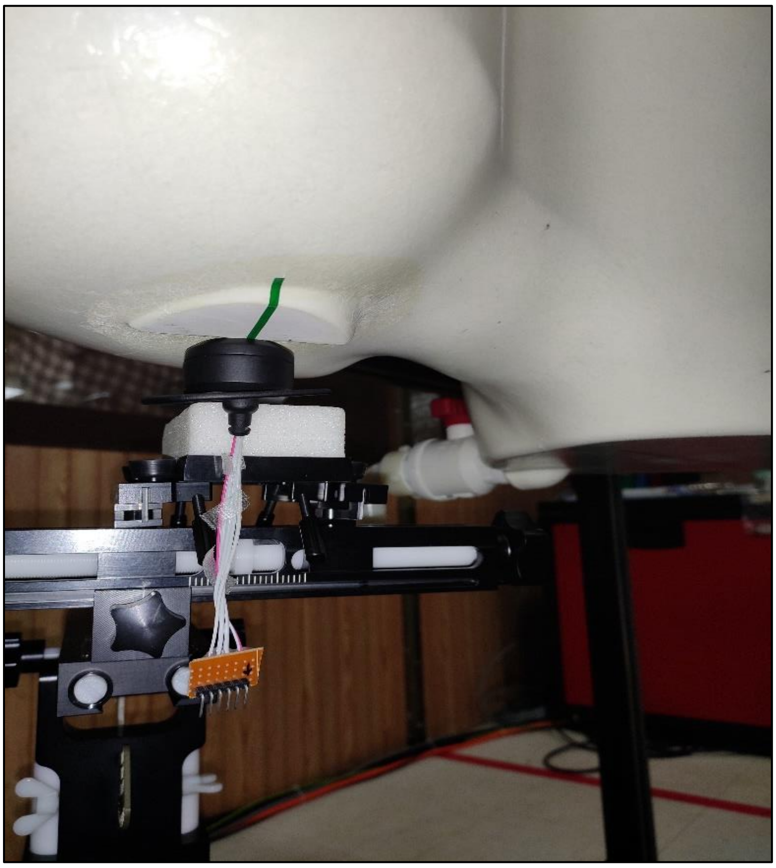


Photo 2 : EUT kept in Cheek position with the Left head phantom

Photo 3 : EUT kept in Front position with the flat phantom

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