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FCC 2.1093
Power Density Evaluation Report

for

LG Electronics Inc.

222, LG-ro, Jinwi-myeon Pyeongtaek-Si, Gyeonggi-Do, 17709 Republic of Korea

Product Name	:	**Notebook Computer**
Model Name	:	**1)15Z90Q (2)15ZB90Q (3)15ZD90Q (4)15ZG90Q**
Brand	:	**LG**
FCC ID	:	**BEJNT-15Z90Q**

Prepared by:	:	**AUDIX Technology Corporation, EMC Department**

Testing Laboratory
1724

The test report is based on a single evaluation of one sample of the above-mentioned products. It does not imply an assessment of the whole production and does not permit the use of the test lab logo. The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. Government.

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TEST REPORT

Applicant	:	LG Electronics Inc.
Manufacturer	:	LG Electronics Inc.
Factory	:	LG Electronics Nanjing New Technology Co., Ltd.
EUT Description		
(1) Product	:	Notebook Computer
(2) Model	:	1)15Z90Q (2)15ZB90Q (3)15ZD90Q (4)15ZG90Q
(3) Brand	:	LG
(4) Power Supply	:	DC 20V, 3.25A

Rules of Compliance and Applicable Standards:

Title 47FCC CFR, Part 2 §2.1093

Audix Technology Corp. tested the equipment mentioned in accordance with the requirements set forth in the above standards. Test results indicate that the equipment tested is capable of demonstrating compliance with the requirements as documented within this report.
Audix Technology Corp. does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens and samples.

Date of Report: 2022. 04. 01

Reviewed by: Annie Yu (Annie Yu/Administrator)

Approved by: Johnny Hsueh (Johnny Hsueh/Section Manager)

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1. REVISION RECORD OF TEST REPORT

Edition No	Issued Date	Revision Summary	Report Number
0	2022. 04. 01	Original Report	EM-SR220018

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2. SUMMARY OF TEST RESULTS

- **For SAR Value**

Test SKU: SKU #1 (with INPAQ Antenna)

Highest Simultaneous Transmission SAR	Reported Body SAR_{1g}	Results
WLAN 6E ANT Main+ WLAN 6E ANT AUX	0.382 (W/kg)	PASS
WLAN 6E ANT AUX+ BT ANT AUX Note 4	0.244 (W/kg)	PASS
WLAN 6E ANT Main+ WLAN 6E ANT AUX + BT ANT AUX	0.443 (W/kg)	PASS

Note: 1. The SAR limit (SAR1g 1.6 W/kg) for general population / uncontrolled exposure is specified in FCC 47 CFR part 2 (2.1093).
2. It is calculated from scale SAR.
3. It is larger than the limit 1.6(W/kg), SAR test exclusion is determined by the SAR to peak location separation ratio.
4. The BT Highest Body SAR_{1g} is 0.061 W/kg, please refer to report number EM-SR220016.

Test SKU: SKU #2 (with LUXSHARE-ICT Antenna)

Highest Simultaneous Transmission SAR	Reported Body SAR_{1g}	Results
WLAN 6E ANT Main+ WLAN 6E ANT AUX	0.382 (W/kg)	PASS
WLAN 6E ANT AUX+ BT ANT AUX Note 4	0.262 (W/kg)	PASS
WLAN 6E ANT Main+ WLAN 6E ANT AUX + BT ANT AUX	0.443 (W/kg)	PASS

Note: 1. The SAR limit (SAR1g 1.6 W/kg) for general population / uncontrolled exposure is specified in FCC 47 CFR part 2 (2.1093).
2. It is calculated from scale SAR.
3. It is larger than the limit 1.6(W/kg), SAR test exclusion is determined by the SAR to peak location separation ratio.
4. The BT Highest Body SAR_{1g} is 0.061 W/kg, please refer to report number EM-SR220016.

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- **For Power Density value**

Test SKU: SKU #1 (with INPAQ Antenna)

Mode	Highest C-Ptot averaging over $4cm^2$(W/m^2)	Limit (W/m^2)	Results
WLAN 6E	4.215	10	PASS

Test SKU: SKU #2 (with LUXSHARE-ICT Antenna)

Mode	Highest C-Ptot averaging over $4cm^2$(W/m^2)	Limit (W/m^2)	Results
WLAN 6E	6.579	10	PASS

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3. GENERAL INFORMATION

3.1. Description of Application

Applicant	LG Electronics Inc. 222, LG-ro, Jinwi-myeon Pyeongtaek-Si, Gyeonggi-Do, 17709 Republic of Korea
Manufacturer	LG Electronics Inc. 222, LG-ro, Jinwi-myeon Pyeongtaek-Si, Gyeonggi-Do, 17709 Republic of Korea
Factory	LG Electronics Nanjing New Technology Co., Ltd. No.346,Yaoxin Road, Economic & Technical Development Zone, Nanjing, China.
Product	Notebook Computer
Model	1)15Z90Q (2)15ZB90Q (3)15ZD90Q (4)15ZG90Q The difference between all models is different in the sales customers.
Brand	LG

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3.2. Description of EUT

Test Model	15Z90Q
Serial Number	N/A
Power Rating	DC 20V, 3.25A
Software Version	XY (X, Y can be 0 to 9 for different SW version not influence RF parameter)
RF Features	WLAN:802.11 a/b/g/n/ac/ax Bluetooth: BT and BLE (BT 5.1)
Transmit Type	See tables below

2.4 GHz	
802.11b	1T1R
802.11g	1T1R
802.11n-HT20	2T2R
802.11n-HT40	2T2R
802.11ax-HE20	2T2R
802.11ax-HE40	2T2R
BT/BLE	1T1R

U-NII Bands	
802.11a	1T1R
802.11n-HT20/802.11ac-VHT20/802.11ax-HE20	2T2R
802.11n-HT40/802.11ac-VHT40/802.11ax-HE40	2T2R
802.11ac-VHT80/802.11ax-HE80	2T2R
802.11ac-VHT160/802.11ax-HE160	2T2R

The MIMO is uncorrelated and supported SDM mode only.

Test Sample

Sample No.	Test Item	Firmware
03	SAR	N/A
04	SAR	N/A

Sample Status	Trial sample
Date of Receipt	2022. 01. 14
Date of Test	2022. 02. 23
Interface Ports of EUT	• One HDMI Port • Two USB Type C Ports • One Earphone Port • One Micro SD Card Slot • Two USB 3.0 Ports
Accessories Supplied	• AC Adapter • LAN Gender

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3.3. Reference Test Guidance

TCB Workshop – April 2021: RF exposure Policies and Procedures
SPEAG DASY6 System Handbook (June 2020)
SPEAG DASY6 Application Note (Interim Procedures for Devices Operating at 6-10GHz)
47 CFR FCC Part 2(§2.1093)
IEC TR 63170:2018
IEC/IEEE 62209-1528:2020
FCC KDB 865664 D01 v01r02
FCC KDB 248227 D01 v02r02
FCC KDB 447498 D04 Interim General RF Exposure Guidance v01
FCC KDB 865664 D01 v01r04
FCC KDB 616217 D04 v01r02

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3.4. Antenna Information

No.	Antenna Part Number	Manufacture	Antenna Type	Frequency (MHz)	Max Gain(dBi)	
					Main	AUX
1.	WA-P-LELE-04-009	INPAQ	Mono-Pole	2400	2.3	2.0
				2450	2.4	**2.6**
				2500	**3.2**	2.4
				5150	4.2	3.5
				5400	4.2	**3.6**
				5850	**4.4**	3.5
				5925	**4.1**	**3.4**
				6525	4.1	3.2
				7125	4.2	2.3

Note 1. 2.4G: Directional gain = $10 \log[(10^{3.2/10} + 10^{2.6/10})/2] = 2.91$dBi
Note 2. UNII Band: (WLAN 5G) Directional gain = $10 \log[(10^{4.4/10} + 10^{3.6/10})/2] = 4.02$dBi
Note 3. UNII Band (WLAN 6G):
5925MHz: Directional gain = $10 \log[(10^{4.1/10} + 10^{3.4/10})/2] = 3.76$dBi
6525MHz: Directional gain = $10 \log[(10^{4.1/10} + 10^{3.2/10})/2] = 3.67$dBi
7125MHz: Directional gain = $10 \log[(10^{4.2/10} + 10^{2.3/10})/2] = 3.53$dBi

No.	Antenna Part Number	Manufacture	Antenna Type	Frequency (MHz)	Main	AUX
2.	L1LRF008-CS-H	LUXSHARE-ICT	Mono-Pole	2400	**6.3**	0.9
				2450	5.7	1.6
				2500	2.7	**3.5**
				5150	-1.5	2.3
				5400	3.4	4.5
				5850	**3.3**	**5.8**
				5925	**2.9**	**4.7**
				6525	3.4	1.3
				7125	-4.9	-1.6

Note 1. 2.4G: Directional gain = $10 \log[(10^{6.3/10} + 10^{3.5/10})/2] = 5.12$dBi
Note 2. UNII Band: (WLAN 5G) Directional gain = $10 \log[(10^{3.3/10} + 10^{5.8/10})/2] = 4.73$dBi
Note 3. UNII Band (WLAN 6G):
5925MHz: Directional gain = $10 \log[(10^{2.9/10} + 10^{4.7/10})/2] = 3.89$dBi
6525MHz: Directional gain = $10 \log[(10^{3.4/10} + 10^{1.3/10})/2] = 2.48$dBi
7125MHz: Directional gain = $10 \log[(10^{-4.9/10} + 10^{-1.6/10})/2] = -2.94$dBi

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3.5. EUT Specifications Assessed in Current Report

Mode	U-NII Band	Fundamental Range (MHz)	Channel Number
802.11ax-HE20	5	5955-6415	24
	6	6435-6515	5
	7	6535-6855	17
	8	6875-7115	13
802.11ax-HE40	5	5965-6405	12
	6	6445-6485	2
	7	6525-6845	9
	8	6885-7085	6
802.11ax-HE80	5	5985-6385	6
	6	6465-6545	2
	7	6625-6785	3
	8	6865-7025	3
802.11ax-HE160	5	6025-6345	3
	6	6505	1
	7	6665	1
	8	6825-6985	2

Mode	Modulation	Data Rate (Mbps)
802.11ax-HE20	OFDMA (BPSK/ QPSK/ 16QAM/ 64QAM/ 256QAM/1024QAM)	Up to 287
802.11ax-HE40		Up to 574
802.11ax-HE80		Up to 1201
802.11ax-HE160		Up to 2402

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3.6. Description of Key Components

3.6.1. For the All Component Lists

Item	Supplier	Model / Type	Character
System	Microsoft	Win11 Home	---
Main Board	LG	Queen MAIN B/D PCB	Main Board (GM) Manufacturer: #1 HannstarBoardTech(Jiang Yin)Corp.,Ltd. #2 Elec&Eltek Company (MCO) Limited.
WLAN SUB Board	LG	15Z90Q SUB B/D	Manufacturer: #1 HannstarBoardTech(Jiang Yin)Corp.,Ltd. #2 Elec&Eltek Company (MCO) Limited. #3 JiangSuHuaShen Electronic co.,ltd (HXF)
CPU (Socket: BGA1744)	Intel	i7-1260P	2.5GHz
	Intel	i5-1240P	2.1GHz
15" LCD Panel	LG Display	LP156WFD(SP)(Z1)	Resolution: 2560 x 1600, 60Hz WQXGAIPS (Touch)
	LG Display	LP156WFC(SP)(Z2)	Resolution: 2560 x 1600, 60Hz WQXGAIPS (Non Touch)
Storage (SSD)	SK hynix	HFM001TD3JX013N	1TB
		HFM512GD3JX013N	512GB
		HFM256GD3JX013N	256GB
	Samsung	MZ-VL21T00	1TB
		MZ-VL25120	512GB
		MZ-VL22560	256GB
Memory (RAM)	Samsung	---	16GB LPDDR5x(On Board)
		---	8GB LPDDR5x(On Board)
	SK Hynix	---	16GB LPDDR5x(On Board)
		---	8GB LPDDR5x(On Board)
Battery Pack	LG	LBV7227E	80Wh, DC7.74V, 80Wh Typ 10336mAh
WLAN Combo Card	Intel	AX211D2W	WLAN and BT, 2x2 PCle M.2 1216 SD adapter card FCC ID: PD9AX211D2 IC: 1000M-AX211D2
WLAN Combo Antenna	LG (INPAQ)	WA-P-LELE-04-009	PCB, Mono-pole Type Main: Black, Aux: Gray
	LG (LUXSHARE-ICT)	L1LRF008-CS-H	PCB, Mono-pole Type Main: Black, Aux: Gray
Keyboard	TIC	KT0120B8E	---
	LITE ON	SN8101	---
Web Camera	Chicony	CKFLF26	---
	Luxvisions	1BF225N3	---

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Item	Supplier	Model / Type	Character
LAN Gender (Type C to LAN)	SUZHOU MEC ELECTRONICS	80-5946-111	(White) 10/100Megabit Ethernet
		80-5946-101	(Black) 10/100 Megabit Ethernet
		80-5946-230	(White) 10/100/1000 Megabit Ethernet
		80-5946-240	(Black) 10/100/1000 Megabit Ethernet
	Type C to LAN: Shielded, Undetached, 0.12m		
	ARIN TECH CO. LTD	GD-08MF-36-WH-LP10	(White) 10/100Megabit Ethernet
		GD-08MF-36-BK-LP11	(Black) 10/100 Megabit Ethernet
		GD-08MF-50-WH-LP12	(White) 10/100/1000 Megabit Ethernet
		GD-08MF-50-BK-LP13	(Black) 10/100/1000 Megabit Ethernet
	Type C to LAN: Shielded, Undetached, 0.12m		
AC Adapter (65W)	LG (HONOR)	ADT-65DSU-D03-2	I/P: AC 100-240V, 1.6A, 50-60Hz O/P: DC 20V, 3.25A
	DC Power Cord: Non-Shielded, Undetached, 1.5m AC Power Cord: Non-Shielded, Detached, 1.0m (2C) (For Other Countries) AC Power Cord: Non-Shielded, Detached, 1.55m (2C) (For US, Canada, Mexico)		

Remark: For more detailed features description, please refer to the manufacturer's specifications or the user manual.

3.6.2. The EUT collocates with following worst components, which are used to establish a basic configuration of system during test:

SKU (Mode)			1	2
Main Board		LG, Queen MAIN B/D PCB	V	V
SUB Board		LG, 15Z90Q SUB B/D	V	V
CPU		Intel, i7-1260P	V	
		Intel, i5-1240P		V
15" LCD Panel		LG Display, LP156WFD(SP)(Z1)	V	
		LG Display, LP156WFC(SP)(Z2)		V
Storage (SSD)		Samsung, 1TB	V	
		SK hynix, 1TB	V	
		Samsung, 256GB		V
		SK hynix, 256GB		V
Memory (RAM)		16GB	V	V
Battery Pack		LG, 80Wh	V	V
Keyboard		LITE ON, SN8101	V	V
Web Camera		Luxvisions, 1BF225N3	V	V
WLAN Combo Card		Intel, AX211D2W	V	V
WLAN Combo Antenna		LG (INPAQ), WA-P-LELE-04-009	V	
		LG (LUXSHARE-ICT), L1LRF008-CS-H		V
Type C #1	AC Adapter	LG (HONOR), ADT-65DSU-D03-2	V	V
Type C #2	Link to LAN Gender	ARIN (Black)	V	V

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3.7. Description of Test Facility

Name of Test Firm	Audix Technology Corporation / EMC Department No. 491, Zhongfu Rd., Linkou Dist., New Taipei City 244, Taiwan, China Tel: +886-2-26092133 Fax: +886-2-26099303 Website : www.audixtech.com Contact e-mail: attemc_report@audixtech.com
Accreditations	The laboratory is accredited by following organizations under ISO/IEC 17025:2017 (1) NVLAP(USA) NVLAP Lab Code 200077-0 (2) TAF(Taiwan) No. 1724
Test Facilities	FCC OET Designation Number under APEC MRA by NCC is : TW1724 ISED CAB Identifier Number under APEC TEL MRA by NCC is TW1724 (1) SAR Room

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3.8. Measurement Uncertainty

cDASY6 Module mmWave Uncertainty Budget Evaluation Distances to the Antennas $> \lambda/2\pi$ In Compliance with IEC/IEEE 63195							
Error Description		Unc. Value ($\pm$dB)	Probab. Distri.	Div.	(c_i)	Std. Unc. ($\pm$dB)	(v_i) v_{eff}
Uncertainty terms dependent on the measurement system							
CAL	Calibration	0.49	N	1	1	0.49	∞
COR	Probe correction	0	R	$\sqrt{3}$	1	0	∞
FRS	Frequency response (BW $\leq$ 1 GHz)	0.20	R	$\sqrt{3}$	1	0.12	∞
SCC	Sensor cross coupling	0	R	$\sqrt{3}$	1	0	∞
ISO	Isotropy	0.50	R	$\sqrt{3}$	1	0.29	∞
LIN	Linearity	0.20	R	$\sqrt{3}$	1	0.12	∞
PSC	Probe scattering	0	R	$\sqrt{3}$	1	0	∞
PPO	Probe positioning offset	0.30	R	$\sqrt{3}$	1	0.17	∞
PPR	Probe positioning repeatability	0.04	R	$\sqrt{3}$	1	0.02	∞
SMO	Sensor mechanical offset	0	R	$\sqrt{3}$	1	0	∞
PSR	Probe spatial resolution	0	R	$\sqrt{3}$	1	0	∞
FLD	Field impedance dependance	0	R	$\sqrt{3}$	1	0	∞
APD	Amplitude and phase drift	0	R	$\sqrt{3}$	1	0	∞
APN	Amplitude and phase noise	0.04	R	$\sqrt{3}$	1	0.02	∞
TR	Measurement area truncation	0	R	$\sqrt{3}$	1	0	∞
DAQ	Data acquisition	0.03	N	1	1	0.03	∞
SMP	Sampling	0	R	$\sqrt{3}$	1	0	∞
REC	Field reconstruction	0.60	R	$\sqrt{3}$	1	0.35	∞
TRA	Forward transformation	0	R	$\sqrt{3}$	1	0	∞
SCA	Power density scaling	-	R	$\sqrt{3}$	1	-	∞
SAV	Spatial averaging	0.10	R	$\sqrt{3}$	1	0.06	∞
SDL	System detection limit	0.04	R	$\sqrt{3}$	1	0.02	∞
Uncertainty terms dependent on the DUT and environmental factors							
PC	Probe coupling with DUT	0	R	$\sqrt{3}$	1	0	∞
MOD	Modulation response	0.40	R	$\sqrt{3}$	1	0.23	∞
IT	Integration time	0	R	$\sqrt{3}$	1	0	∞
RT	Response time	0	R	$\sqrt{3}$	1	0	∞
DH	Device holder influence	0.10	R	$\sqrt{3}$	1	0.06	∞
DA	DUT alignment	0	R	$\sqrt{3}$	1	0	∞
AC	RF ambient conditions	0.04	R	$\sqrt{3}$	1	0.02	∞
AR	Ambient reflections	0.04	R	$\sqrt{3}$	1	0.02	∞
MSI	Immunity / secondary reception	0	R	$\sqrt{3}$	1	0	∞
DRI	Drift of the DUT	-	R	$\sqrt{3}$	1	-	∞
Combined Standard Uncertainty						0.76	∞
Expanded Standard Uncertainty (95%)						1.52	

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4. MEASUREMENT EQUIPMENTLIST

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	System Verification Device	SPEAG	5G Verification Source 10 GHz	2014	2021. 11. 01	1 Year
2.	E-Field Probe	SPEAG	EUmmWV4	9544	2021. 04. 01	3 Years
3.	Data Acquisition Electronic	SPEAG	DAE4	1337	2021. 09. 20	1 Year
4.	E-Field Probe	SPEAG	EX3DV4	3855	2021. 09. 24	1 Year
5.	Data Acquisition Electronic	SPEAG	DAE3	393	2021. 04. 09	1 Year
6.	Stäubli Robot TX90 XL	Stäubli	TX90	F12/5K9SA1/ A101	N.C.R.	N.C.R.
7.	mmWave Phantom	SPEAG	QD 015 025CA	1059	N.C.R.	N.C.R.
8.	D6.5GHzV2 system Validation Dipole	SPEAG	D6.5GHzV2	1051	2021. 11. 01	1 Year
9.	ENA Network Analyzer	Agilent	E5071C-285	MY46215502	2021. 04. 08	1 Year
10.	SAR Software	SPEAG	Dasy6 SAR	V16.0.0.016	N.C.R.	N.C.R.
11.	SAR Software	SPEAG	C-6 module mmWave	V 2.02.34	N.C.R.	N.C.R.

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5. SAR MEASUREMENT SYSTEM

5.1. 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 modeling. The standard recommends limits for two tiers of groups, occupational/controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled.

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:

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

SAR is expressed in units of Watts per kilogram (W/kg)
SAR measurement can be related to the electrical field in the tissue by

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

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

5.2. 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 DASY5 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.

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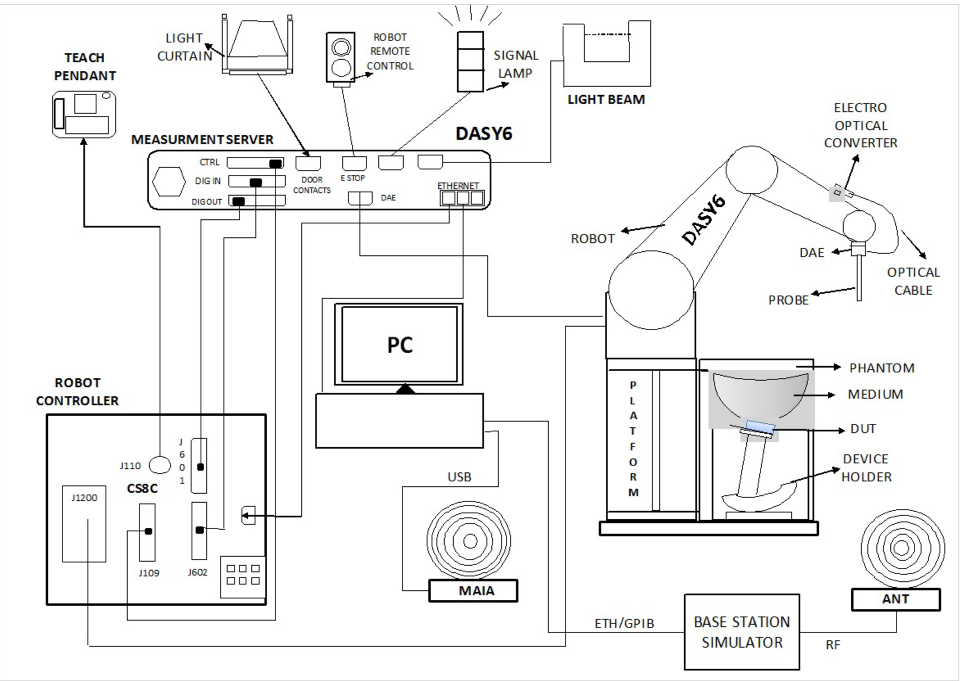

Fig-3.1 DASY6 System Setup

5.2.1. Robot

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

- High precision (repeatability ±0.035 mm)
- High reliability (industrial design)
- Jerk-free straight movements
- Low ELF interference (the closed metallic construction shields against motor control fields)

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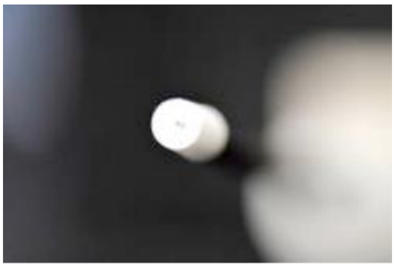
5.2.2. Probes

Model	EUmmWV4,
Frequency	750 MHz to 110 GHz
Dynamic Range	< 20 V/m - 10000 V/m with PRE-10 < 50 V/m - 3000 V/m minimum
Linearity	< ±0.2 dB
Hemispherical Isotropy	< 0.5 dB
Position Precision	< 0.2 mm
Dimensions	Overall length: 337 mm (tip: 20 mm) Tip diameter: encapsulation 8 mm (internal sensor < 1mm) Distance from probe tip to dipole centers: < 2 mm Sensor displacement to probe's calibration point: < 0.3 mm



5.2.3. Data Acquisition Electronics (DAE)

Model	DAE4
Construction	Signal amplifier, multiplexer, A/D converter and control logic. Serial optical link for communication with DASY4/5 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

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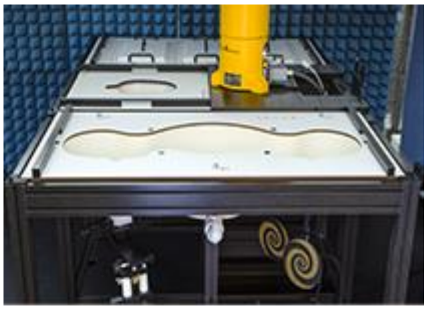
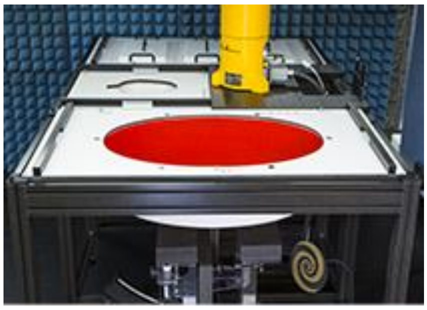
5.2.4. Phantom

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



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



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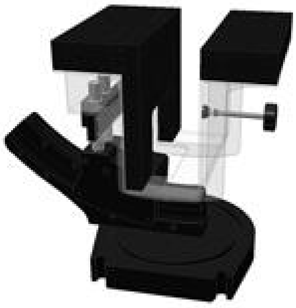
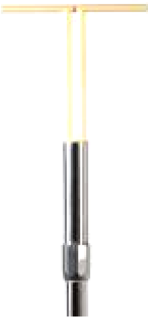
5.2.5. Device Holder

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, IEEE, FCC or other specifications. The device holder can be locked for positioning at different phantom sections (left head, right head, flat).	
Material	POM	

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	

5.2.6. Reference Dipole

Model	System Validation Dipoles	
Construction	Symmetrical dipole with l/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 6500 MHz	
Return Loss	> 20 dB	
Power Capability	> 100 W (f < 1GHz), > 40 W (f > 1GHz)	

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5.2.7. 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 in Table-5.1.

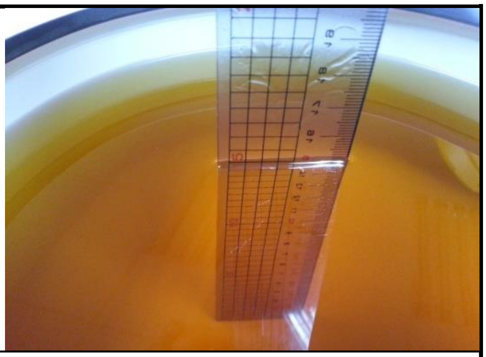

Photo of Liquid Height

The dielectric properties of the head tissue simulating liquids are defined in IEEE 1528 and FCC OET 65 Supplement C Appendix C. For the body tissue simulating liquids, the dielectric properties are defined in FCC OET 65 Supplement C Appendix C. The dielectric properties of the tissue simulating liquids were verified prior to the SAR evaluation using an Agilent E5071C-285 Dielectric Probe Kit and an Agilent Network Analyzer.

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Table-5.1 Targets of Tissue Simulating Liquid

Target Frequency [MHz]	Target Permittivity (εr)	Range of ± 5%	Target Conductivity σ[s/m]	Range of ± 5%
750	41.9	39.805 ~ 43.995	0.89	0.846 ~ 0.935
835	41.5	39.425 ~ 43.575	0.90	0.855 ~ 0.945
900	41.5	39.425 ~ 43.575	0.97	0.922 ~ 1.019
1450	40.5	38.475 ~ 42.525	1.20	1.140 ~ 1.260
1640	40.3	38.285 ~ 42.315	1.29	1.226 ~ 1.355
1750	40.1	38.095 ~ 42.105	1.37	1.302 ~ 1.439
1800	40.0	38.000 ~ 42.000	1.40	1.330 ~ 1.470
1900	40.0	38.000 ~ 42.000	1.40	1.330 ~ 1.470
2000	40.0	38.000 ~ 42.000	1.40	1.330 ~ 1.470
2300	39.5	37.525 ~ 41.475	1.67	1.587 ~ 1.754
2450	39.2	37.240 ~ 41.160	1.80	1.710 ~ 1.890
2600	39.0	37.050 ~ 40.950	1.96	1.862 ~ 2.058
3500	37.9	36.005 ~ 39.795	2.91	2.765 ~ 3.056
5200	36.0	34.2.00 ~ 37.800	4.66	4.427 ~ 4.893
5300	35.9	34.105 ~ 37.695	4.76	4.522 ~ 4.998
5500	35.6	33.820 ~ 37.380	4.96	4.712 ~ 5.208
5600	35.5	33.725 ~ 37.275	5.07	4.817 ~ 5.324
5800	35.3	33.535 ~ 37.065	5.27	5.007 ~ 5.534
6000	35.1	33.345~ 36.855	5.48	5.206 ~ 5.754
6500	34.5	32.775 ~ 36.225	6.07	5.767 ~ 6.374
7000	33.9	32.205 ~ 35.595	6.65	6.318 ~ 6.983

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Table-5.2-1 Recipes of Tissue Simulating Liquid, 30MHz to 900MHz

Frequency (MHz)	**30**	**50**		**144**		**450**		**835**	**900**	
Recipe source number	3	3	2	2	3	2	4	2	2	4
Ingredients (% by weight)										
De-ionized water	48,30	48,30	53,53	55,12	48,30	48,53	56	50,36	50,31	56
Tween 20			44,70	43,31		49,51		48,39	48,34	
Oxidized mineral oil							44			44
Diethylenglycol monohexylether										
Triton X-100										
Diacetin	50,00	50,00			50,00					
DGBE										
NaCl	1,60	1,60	1,77	1,57	1,60	1,96		1,25	1,35	
Additives and salt	0,10	0,10			0,10					
Measured temperature dependence										
Temp. (°C)			21	21		21	20	21	21	20
$\varepsilon_{\text{liquid temp. unc.}}$ (%)	0,8	0,1			0,1	0,1		0,04	0,04	
$\sigma_{\text{liquid temp. unc.}}$ (%)	2,8	2,8			2,6	4,2		1,6	1,6	

Table-5.2-2 Recipes of Tissue Simulating Liquid, 1800MHz to 10000MHz

Frequency (MHz)	**1 800**		**2 450**	**4 000**	**5 000**	**5 200**	**5 800**	**6 000**	**8 000**	**10 000**
Recipe source number	2	4	4	4	4	1	1	4	5	5
Ingredients (% by weight)										
De-ionized water	54,23	56	56	56	56	65,53	65,53	56	67,8	66,0
Tween	45,27								31,1	33,0
Oxidized mineral oil		44	44	44	44			44		
Diethylenglycol monohexylether						17,24	17,24			
Triton X-100						17,24	17,24			
Diacetin										
DGBE										
NaCl	0,50									
Additives and salt										
Measured temperature dependence										
Temp. (°C)	21	20	20	20	20	22	22	20	20	20
$\varepsilon_{\text{liquid temp. unc.}}$ (%)	0,4					1,7	1,8			
$\sigma_{\text{liquid temp. unc.}}$ (%)	2,3					2,7	2,6			

NOTE 1 Multiple columns under a single frequency indicate optional recipes.

NOTE 2 Recipe source numbers: 1 verified by different labs, 2 Reference [59], 3 developed by IT'IS Foundation, 4 developed by IT'IS Foundation, 5 Reference [60].

NOTE 3 The values of $\varepsilon_{\text{liquid temp. unc.}}$ and $\sigma_{\text{liquid temp. unc.}}$ are liquid temperature uncertainties described in O.9.6, based on measurements of the applicable liquid recipes given above. These are not part of the original publications but have been subsequently developed by the project team.

NOTE 4 The recipes at 8 000 MHz and 10 000 MHz are sufficiently broadband that they cover the frequency range of 6 000 MHz to 10 000 MHz within a tolerance of ±10 % for permittivity and conductivity.

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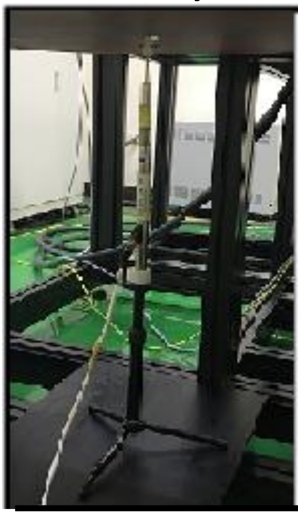
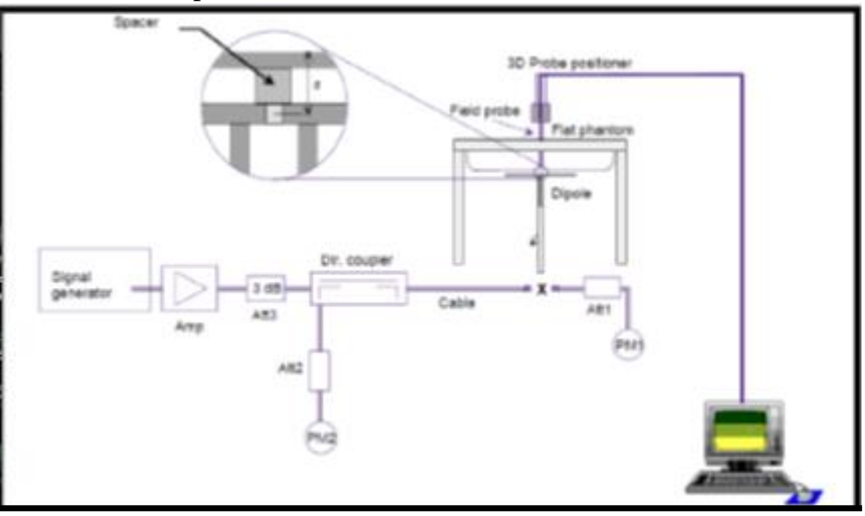
5.3. SAR System Verification

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.





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 power meter PM1 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 6.5 GHz) at the dipole connector and the power meter PM2 is read at that level. After connecting the cable to the dipole, the signal generator is readjusted for the same reading at power meter PM2.

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 %.

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5.3.1. SAR System Verification Result

<table>
<tr><td colspan="11">Dipole Kit: D6.5GHzV2

Test Date: 2022. 02. 17 Liquid Temp. [℃]: 21.0</td></tr>
<tr><td>Frequency [MHz]</td><td colspan="5">1g SAR</td><td colspan="5">10g SAR</td></tr>
<tr><td rowspan="3">6500MHz</td><td>Zoom Scan to 100mW</td><td>Normalize to 1W</td><td colspan="3">Target Value Reference result ± 10% window</td><td>Zoom Scan to 100mW</td><td>Normalize to 1W</td><td colspan="3">Target Value Reference result ± 10% window</td></tr>
<tr><td rowspan="2">29.9</td><td rowspan="2">299</td><td colspan="3">288</td><td rowspan="2">5.36</td><td rowspan="2">53.6</td><td colspan="3">53.6</td></tr>
<tr><td>259.20</td><td>to</td><td>316.80</td><td>48.24</td><td>to</td><td>58.96</td></tr>
</table>

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5.3.2. SAR System Check Data

.

Measurement Report for D6.5GHz, , , UID 0 -, Channel 0 (6500.0MHz)

Device under Test Properties

Model, Manufacturer	Dimensions [mm]	IMEI	DUT Type
D6.5GHz,	50.0 x 10.0 x 8.0		Other

Exposure Conditions

Phantom Section, TSL	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor	TSL Conductivity [S/m]	TSL Permittivity
Flat, HSL	,		, 0--	6500.0, 0	5.55	6.08	34.0

Hardware Setup

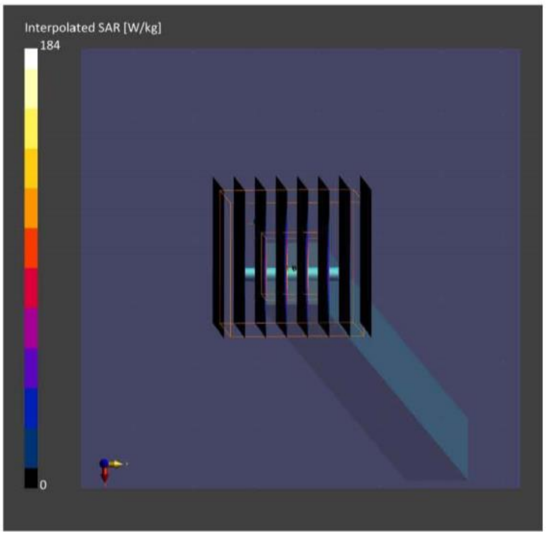
Phantom	TSL, Measured Date	Probe, Calibration Date	DAE, Calibration Date
ELI V5.0 (20deg probe tilt) - 1170	HBBL-600-10000	EX3DV4 - SN3855, 2021-09-24	DAE4 Sn1337, 2021-09-20

Scan Setup

	Area Scan	Zoom Scan
Grid Extents [mm]	51.0 x 85.0	22.0 x 22.0 x 22.0
Grid Steps [mm]	8.5 x 8.5	3.4 x 3.4 x 1.4
Sensor Surface [mm]	3.0	1.4
Graded Grid	Yes	Yes
Grading Ratio	1.5	1.4
MAIA	N/A	N/A
Surface Detection	VMS + 6p	VMS + 6p
Scan Method	Measured	Measured

Measurement Results

	Area Scan	Zoom Scan
Date	2022-02-17	2022-02-17
psSAR1g [W/kg]	26.9	29.9
psSAR10g [W/kg]	5.65	5.36
Power Drift [dB]	-0.13	0.22
Power Scaling	Disabled	Disabled
Scaling Factor [dB]		
TSL Correction	No correction	No correction
M2/M1 [%]		51.4
Dist 3dB Peak [mm]		4.1



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5.4. 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

5.4.1. Area & Zoom Scan Procedure

According to IEC/IEEE 62209-1528, 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)	≤ 15mm	≤ 12mm	≤ 12mm	≤ 10mm	≤ 10mm
Zoom Scan (Δx, Δy)	≤ 8mm	≤ 5mm	≤ 5mm	≤ 4mm	≤ 4mm
Zoom Scan (Δz)	≤ 5mm	≤ 5mm	≤ 4mm	≤ 3mm	≤ 2mm
Zoom Scan Volume	≥30mm	≥30mm	≥28mm	≥25mm	≥22mm

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.

According to IEC/IEEE 62209-1528, if the zoom scan measured as specified in the preceding paragraphs complies with both of the following items, or if the peak spatial-average SAR is below 0.1 W/kg, no additional measurements are needed:

(1) The smallest horizontal distance from the local SAR peaks to all points 3 dB below the SAR peak shall be larger than the horizontal gird steps in both x and y directions (Δx, Δy). This shall be checked for the measured zoom scan plane conformal to the phantom at the distance z_{M1}.
(2) The ratio of the SAR at the second measured point (M2) to the SAR at the closest measured point (M1) at the x, y location of the measured mazimum SAR value shall be at least 30%.

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5.4.2. Volume Scan Procedure

The volume scan is used for assess overlapping SAR distributions for antennas transmitting in different frequency bands. It is equivalent to an oversized zoom scan used in standalone measurements. The measurement volume will be used to enclose all the simultaneous transmitting antennas. For antennas transmitting simultaneously in different frequency bands, the volume scan is measured separately in each frequency band. In order to sum correctly to compute the 1g aggregate SAR, the EUT remain in the same test position for all measurements and all volume scan use the same spatial resolution and grid spacing. When all volume scan were completed, the software, SEMCAD postprocessor can combine and subsequently superpose these measurement data to calculating the multiband SAR.

5.4.3. 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.

5.4.4. Spatial Peak SAR Evaluation

The procedure for spatial peak SAR evaluation has been implemented according to the test standard. It can be conducted for 1g and 10g, as well as for user-specific masses. The DASY software includes all numerical procedures necessary to evaluate the spatial peak SAR value.

The base for the evaluation is a "cube" measurement. The measured volume must include the 1g and 10g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan.

The entire evaluation of the spatial peak values is performed within the post-processing engine (SEMCAD). The system always gives the maximum values for the 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

(a) Extraction of the measured data (grid and values) from the Zoom Scan
(b) Calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
(c) Generation of a high-resolution mesh within the measured volume
(d) Interpolation of all measured values form 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

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5.4.5. 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.

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6. POWER DENSITY MEASUREMENT SYSTEM

6.1. Definition of Power Density

- The power density for an electromagnetic field represents the rate of energy transfer per unit area. The local power density at a given spatial point is deduced from electromagnetic fields by the following formula:
  S energy per unit time and unit area crossing the infinitesimal surface d*A* characterized by the normal unit vector ˆn

$$S = \frac{1}{T}\int (\mathbf{E}\times\mathbf{H}) \cdot \hat{\mathbf{n}} \mathrm{d}T$$

  where E and H are the electric and magnetic fields as function of time, respectively, and T is the period of the waveform.

- The spatial-average power density distribution on the evaluation surface is determined per the IEC TR 63170. The spatial area, A is specified by the applicable exposure limit or regulatory requirements. The circular shape was used.

$$S_{\mathrm{av}} = \frac{1}{2A}\Re\left(\int \mathbf{E}\times\mathbf{H}^{*} \cdot \hat{\mathbf{n}} \mathrm{d}A\right)$$

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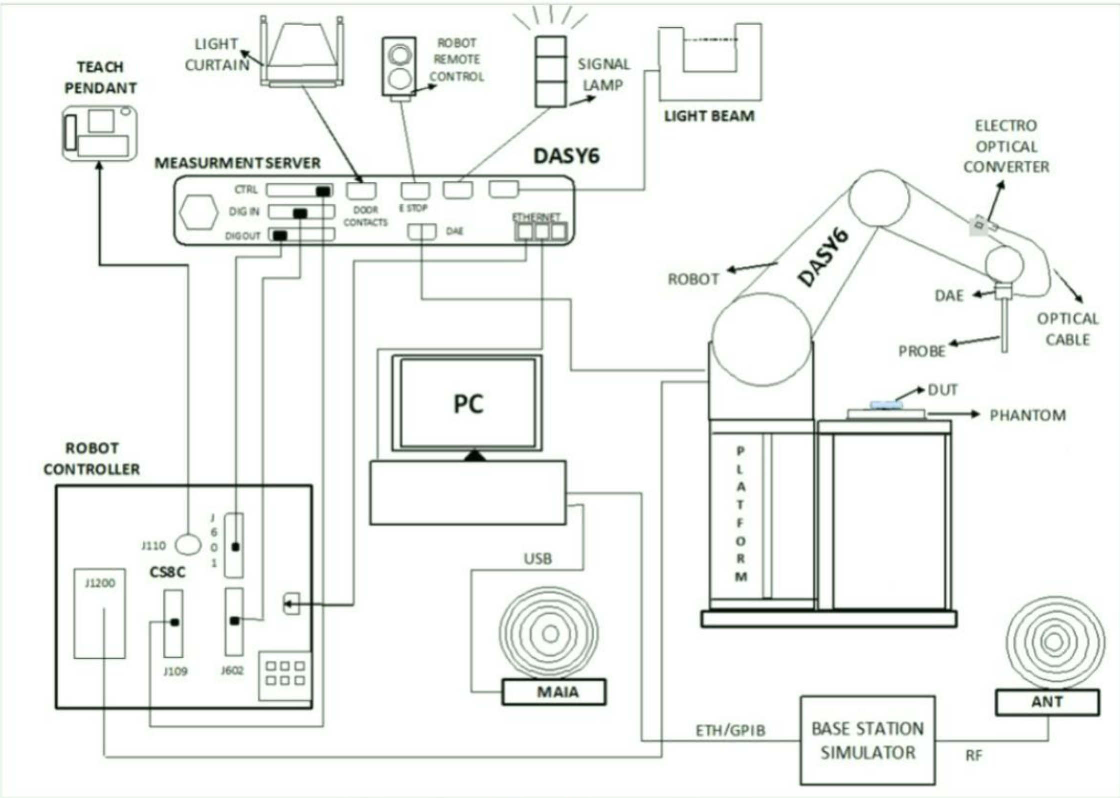
6.2. Measurement Setup

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.



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6.2.1. Robot

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

- High precision (repeatability ±0.035 mm)
- High reliability (industrial design)
- Jerk-free straight movements
- Low ELF interference (the closed metallic construction shields against motor control fields)

6.2.2. EUmmWv2 mm-Wave Probe

The EUmmWV2 probe is based on the pseudo-vector probe design, which not only measures the field magnitude but also derives its polarization ellipse. This probe concept also has the advantage that the sensor angle errors or distortions of the field by the substrate can be largely nullified by calibration. This is particularly important as, at these very high frequencies, field distortions by the substrate are dependent on the wavelength. The design entails two small 0.8 mm dipole sensors mechanically protected by high-density foam, printed on both sides of a 0.9 mm wide and 0.12 mm thick glass substrate. The body of the probe is specifically constructed to minimize distortion by the scattered fields.

The probe consists of two sensors with different angles arranged in the same plane in the probe axis. Three or more measurements of the two sensors are taken for different probe rotational angles to derive the amplitude and polarization information. These probes are the most flexible and accurate probes currently available for measuring field amplitude.

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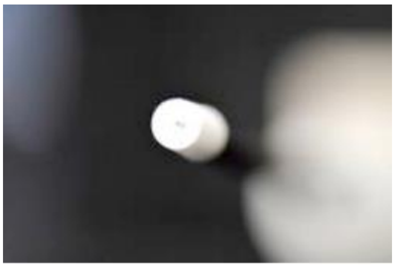
The probe design allows measurements at distances as small as 2 mm from the sensors to the surface of the device under test (DUT). The typical sensor to probe tip distance is 1.5 mm. The exact distance is calibrated.

Model	EUmmWV4	
Frequency	750 MHz to 110 GHz	
Dynamic Range	< 20 V/m - 10000 V/m with PRE-10 < 50 V/m - 3000 V/m minimum	
Linearity	< ±0.2 dB	
Hemispherical Isotropy	< 0.5 dB	
Position Precision	< 0.2 mm	
Dimensions	Overall length: 337 mm (tip: 20 mm) Tip diameter: encapsulation 8 mm (internal sensor < 1mm) Distance from probe tip to dipole centers: < 2 mm Sensor displacement to probe's calibration point: < 0.3 mm	

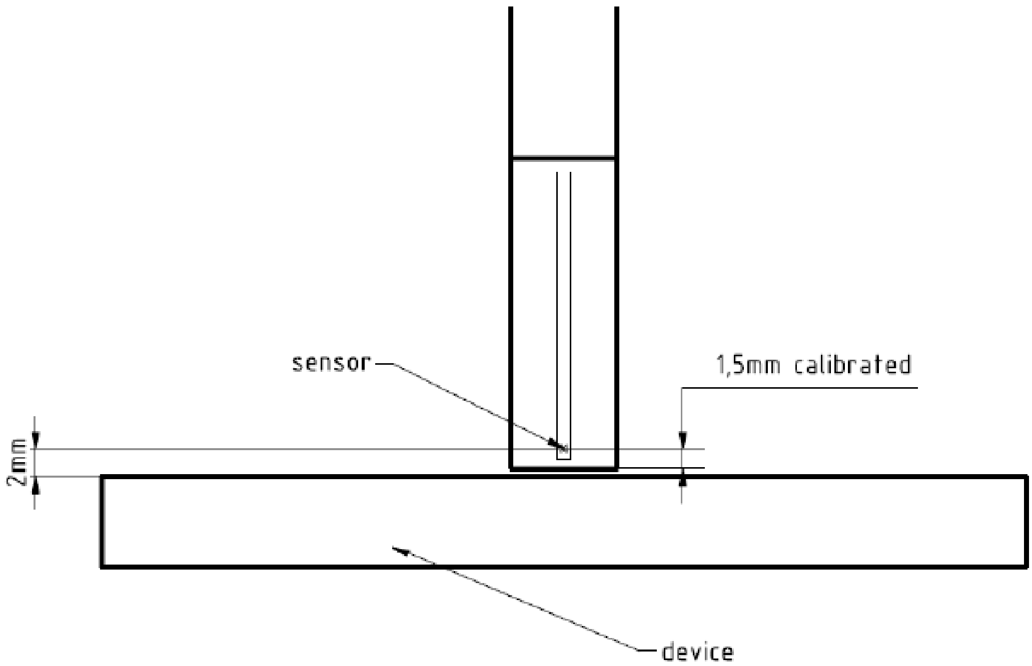


Illustration of Distance-Sensor to EUT Surface

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6.2.3. System Verification Sources

Item	5G Verification Source 10 GHz	
Frequency	10GHz at 10mm from the antenna	
E-field polarization	linear	
Input power	max.20W	
Connector	SMA	
Operation	requires a stable source with known forward power to perform system performance check or validation	

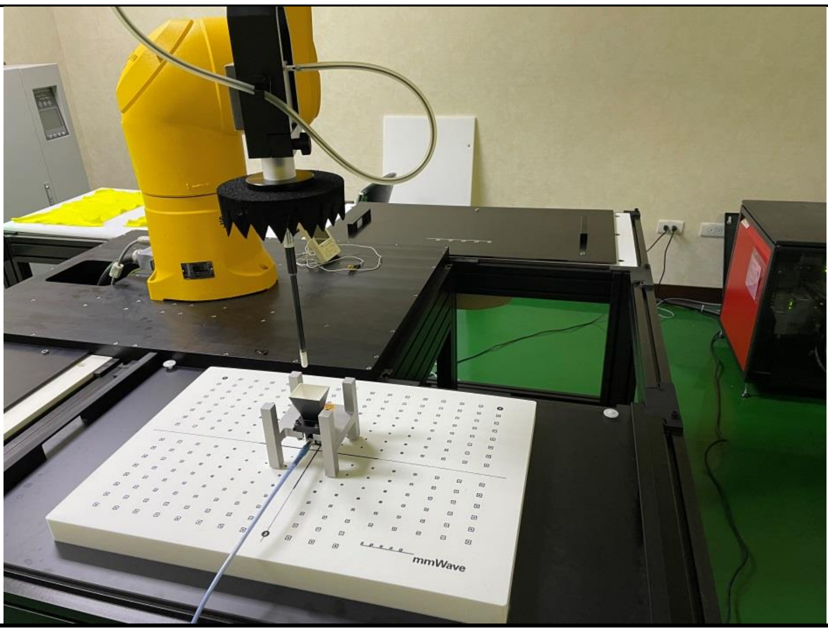
6.3. Power Density System Verification

The system was verified to be within ±0.66 dB of the power density targets on the calibration certificate according to the test system specification in the user's manual and calibration facility recommendation. The ±0.66 dB deviation threshold represents the expanded uncertainty for system performance checks using SPEAG's mmWave verification sources. The same spatial resolution and measurement region used in the source calibration was applied during the system check.

System check using 10 GHz source to support 6-7GHz incident-PD results done with EUmmWV probe, the test procedure was following by the SPEAG AppNote Procedures for Device Operating at 6 – 10GHz.

Frequency (GHz)	Grid Step	Grid Extent X/Y (mm)	Measurement Points
10	0.25 (λ/4)	120/120	16x16

System Verification Setup Photo



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6.3.1. System Verification Result

System Verification Antenna: 5G Verfication Source 10GHz Test Date: 2022. 02. 23					
Square Averaging					
Frequency	Avg. Area	Target Avg Power Density (W/m^2)	Measured Avg Power Density (W/m^2)	Difference (dB)	Uncertainty (dB)
10GHz	$4cm^2$	149.00	133.00149	-0.49	±0.66
Note: Distance Horn Aperture to measured plane is 10.0m					

Note:

1. The difference between the normalized measured local power density and the numerically validated target value is within the reported expanded uncertainty of the measurement system
2. The difference between the measured local power density and the measured reference value is within ±10 % for system repeatability.

The measured reference value is determined for the individual measurement system after calibration, using the same source.

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Measurement Report for Device, FRONT, Validation band, UID 0 -, Channel 10000 (10000.0MHz)

Device under Test Properties

Model, Manufacturer	Dimensions [mm]	IMEI	DUT Type
, Device	100.0 x 100.0 x 100.0		Other

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor
5G Air	FRONT, 10.00	Validation band	CW, 0--	10000.0, 10000	1.0

Hardware Setup

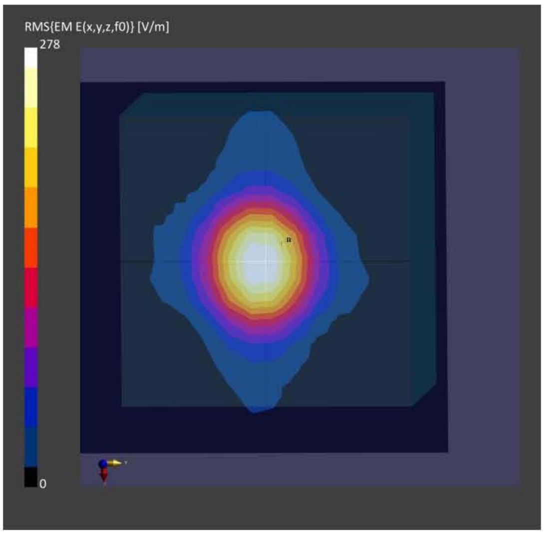
Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave- 1059	Air---	EUmmWV4 - SN9544_F1-55GHz, 2021-04-01	DAE3 Sn393, 2021-04-09

Scan Setup

	5G Scan
Grid Extents [mm]	120.0 x 120.0
Grid Steps [lambda]	0.25 x 0.25
Sensor Surface [mm]	10.0
MAIA	N/A

Measurement Results

	5G Scan
Date	2022-02-23
Avg. Area [cm^2]	4.00
psPDn+ [W/m^2]	129
psPDtot+ [W/m^2]	133
psPDmod+ [W/m^2]	137
E_{max} [V/m]	278
Power Drift [dB]	0.01



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6.4. Power Density Measurement Procedure

Please refer to standard IEC TR 63170 section 6.4.2.

6.4.1. Total field and power density reconstruction

Computation of the power density in general requires knowledge of the electric (E-) and magnetic (H-) field amplitudes and phases in the plane of incidence. Reconstruction of these quantities from pseudo-vector E-field measurements is feasible, as they are constrained by Maxwell's equations. A reconstruction approach based on the Gerchberg–Saxton algorithm has been developed, which benefits from the availability of the E-field polarization ellipse information obtained with the probe. This reconstruction algorithm, together with the ability of the probe to measure extremely close to the source without perturbing the field, permits reconstruction of the E- and H-fields, as well as of the power density, on measurement planes located as near as λ/5 away.

6.4.2. Power density averaging

The average of the reconstructed power density has been evaluated over a circular area in each measurement plane. The area of the circle is defined by the user; for this study the area was defined as 1 cm^2 and 4 cm^2. Note that the average is only evaluated for grid points where the averaging circle is completely filled with values; for points at the edge where the averaging circle is only partly filled with values, the averaged power density is set to zero.

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7. SAR MEASUREMENT EVALUATION

7.1. EUT Configuration and Setting

Body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories. The body-worn accessory procedures in KDB 447498 D01 are used to test for body-worn accessory SAR compliance, without a headset connected to it. This enables the test results for such configuration to be compatible with that required for hotspot mode when the body-worn accessory test separation distance is greater than or equal to that required for hotspot mode. When the reported SAR for a body-worn accessory, measured without a headset connected to the handset, is > 1.2 W/kg, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a headset attached to the handset.

Body-worn accessories that do not contain metallic or conductive components may be tested according to worst-case exposure configurations, typically according to the smallest test separation distance required for the group of body-worn accessories with similar operating and exposure characteristics. All body-worn accessories containing metallic components are tested in conjunction with the host device.

Body-worn accessory SAR compliance is based on a single minimum test separation distance for all wireless and operating modes applicable to each body-worn accessory used by the host, and according to the relevant voice and/or data mode transmissions and operations. If a body-worn accessory supports voice only operations in its normal and expected use conditions, testing of data mode for body-worn compliance is not required.

A conservative minimum test separation distance for supporting off-the-shelf body-worn accessories that may be acquired by users of consumer handsets is used to test for body-worn accessory SAR compliance. This distance is determined by the handset manufacturer, according to the requirements of Supplement C 01-01. Devices that are designed to operate on the body of users using lanyards and straps, or without requiring additional body-worn accessories, will be tested using a conservative minimum test separation distance ≤ 5 mm to support compliance.

7.2. EUT Testing Position

The SAR testing required mode is listed as below.

Antenna	Front Face	Rear Face	Top Side	Bottom Side	Left Side	Right Side	Screen Side
WLAN 6G				√			√

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7.3. Tissue Calibration Result

The dielectric parameters of the liquids were verified prior to the SAR evaluation using Aligent Dielectric Probe Kit and Aligent E5071C Vector Network Analyzer.

<table>
<tr><td colspan="9">Tissue Simulate Measurement</td></tr>
<tr><td rowspan="2">Frequency [MHz]</td><td rowspan="2">Description</td><td colspan="6">Dielectric Parameters</td><td rowspan="2">Tissue Temp. [℃]</td></tr>
<tr><td colspan="3">ε_r</td><td colspan="3">σ[s/m]</td></tr>
<tr><td rowspan="3">6500MHz</td><td rowspan="2">Reference result
± 5% window</td><td colspan="3">34.50</td><td colspan="3">6.07</td><td rowspan="2">N/A</td></tr>
<tr><td>32.775</td><td>to</td><td>36.225</td><td>5.767</td><td>to</td><td>6.374</td></tr>
<tr><td>2022. 02. 17</td><td colspan="3">34.0</td><td colspan="3">6.08</td><td>21</td></tr>
</table>

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8. SAR EXPOSURE LIMITS

8.1. RF Exposure Limits for Frequencies Below 6GHz

- 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.

- Controlled Environment

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

Type Exposure	Uncontrolled Environment Limit	Controlled Environment Limit
Spatial Peak SAR (1g cube tissue for brain or body)	1.60 W/kg	8.00 W/kg
Spatial Average SAR (whole body)	0.08 W/kg	0.40 W/kg
Spatial Peak SAR (10g for hands, feet, ankles and wrist)	4.00 W/kg	20.00 W/kg

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8.2. RF Exposure Limits for Frequencies Above 6GHz

Per FCC §1.1310 (d)(3), the MPE limits are applied for frequencies above 6GHz. Power Density is expressed in units of W/m^2 or mW/cm^2.

Peak Spatially Averaged Power Density was evaluated over a circular area 4 cm^2 per interim FCC Guidance for near-field power density evaluations per October 2018 TCB Workshop notes.

Type Exposure	Uncontrolled Environment Limit	Controlled Environment Limit
Power Density	$1.0mW/cm^2$	$5.0mW/cm^2$

Note: $1.0mW/cm^2$ is $10W/m^2$.

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9. CONDUCTED POWER MEASUREMENT

The measuring conducted power and maximum Tune-up power are shown as below:

- OFDM Modulation

Mode	U-NII Band	Centre Frequency (MHz)	Output Power (dBm)						SAR Test
			Chain 0 (AUX)			Chain 1 (Main)			
			Average Power	Tune-Up Limit	Scale Factor	Average Power	Tune-Up Limit	Scale Factor	
802.11ax-HE20	5	5955	1.88	3.00	---	2.25	3.00	---	No
		6175	1.56	2.00	---	1.77	2.00	---	No
		6415	1.44	2.00	---	1.95	2.00	---	No
	6	6435	1.76	2.00	---	0.81	1.00	---	No
		6475	1.38	1.50	---	0.77	1.00	---	No
		6515	1.33	2.00	---	0.85	1.00	---	No
	7	6535	-1.65	-1.00	---	-1.66	-1.50	---	No
		6695	-1.55	-0.50	---	-1.45	-1.00	---	No
		6855	-0.88	0.00	---	-1.41	-1.00	---	No
	8	6875	-0.55	-0.50	---	0.25	0.50	---	No
		6995	-0.04	0.00	---	0.02	0.50	---	No
		7115	-5.33	-4.50	---	-5.65	-5.50	---	No
802.11ax-HE40	5	5965	5.55	6.00	---	4.44	4.50	---	No
		6165	4.55	5.00	---	4.25	4.50	---	No
		6405	5.17	5.50	---	4.34	4.50	---	No
	6	6445	5.44	6.00	---	4.15	4.50	---	No
		6485	4.55	5.00	---	4.11	4.50	---	No
	7	6525	4.57	5.00	---	4.47	5.00	---	No
		6685	4.00	4.00	---	3.96	4.50	---	No
		6845	4.11	4.50	---	3.77	4.00	---	No
	8	6885	4.03	4.50	---	3.55	4.00	---	No
		7005	3.85	4.00	---	3.02	3.50	---	No
		7085	4.02	5.00	---	3.57	4.00	---	No
802.11ax-HE80	5	5985	6.50	7.00	---	6.71	7.00	---	No
		6145	6.62	7.50	---	6.77	7.50	---	No
		6385	6.76	7.50	---	7.15	7.50	---	No
	6	6465	6.82	7.50	---	7.12	7.50	---	No
		6545	6.68	7.00	---	6.98	7.50	---	No
	7	6625	5.87	6.00	---	6.04	6.50	---	No
		6705	5.63	6.00	---	5.71	6.00	---	No
		6785	5.65	6.00	---	5.71	6.00	---	No
	8	6865	5.64	6.50	---	5.81	6.00	---	No
		6945	5.83	6.00	---	6.04	6.50	---	No
		7025	5.92	6.00	---	6.13	6.50	---	No

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Mode	U-NII Band	Centre Frequency (MHz)	Output Power (dBm)						SAR Test
			Chain 0 (AUX)			Chain 1 (Main)			
			Average Power	Tune-Up Limit	Scale Factor	Average Power	Tune-Up Limit	Scale Factor	
802.11ax-HE160	5	6025	9.37	9.5	1.03	9.69	10.00	1.07	No
		6185	9.80	10.00	1.05	9.83	10.00	1.04	Yes
		6345	9.76	10.00	1.06	10.03	10.50	1.11	Yes
	6	6505	9.50	10.00	1.12	9.83	10.00	1.04	Yes
	7	6665	8.54	9.0	---	8.92	9.0	---	No
		6825	8.73	9.00	1.06	8.85	9.00	1.04	Yes
	8	6985	8.83	9.00	1.04	9.12	9.50	1.09	Yes

Note: Per PCB workshop April 2021 U-NII 6-7GHz Interim procedure, Start with minimum of test channels across full 5925-7125MHz band and adapt conducted power and SAR test reduction procedures of KDB 248227 v02r02.

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10. TEST RESULT

10.1. SAR Test Result

Test Date	2022. 02. 17	Temp./Hum.	23℃/45%
Test Voltage	AC 120V, 60Hz (with AC Adapter)	Tested by	Sean Wang

Test SKU: SKU #1 (with INAPQ Antenna)

Liquid Temperature : 21.0℃										Depth of Liquid:＞15cm		
Test Mode: WIFI 6E												
Remark	Test Position: Body	Antenna Position	Separation Distance (mm)	Freque-ncy	Conducted Power (dBm)	Maximum Tune-up (dBm)	SAR 1g (W/kg)	Scale Factor	Scale SAR	Limit (W/kg)	Estimated epithial APD Note 2	
											1 cm^2	4 cm^2
802.11ax-HE160												
Antenna: Chain 0 (AUX)												
	Screen	Fixed	5	6185	9.80	10.00	0.157	1.05	0.164	1.60	1.570	0.836
Note 1	Screen	Fixed	5	6345	9.76	10.00	0.173	1.06	**0.183**	1.60	1.730	1.250
	Screen	Fixed	5	6505	9.50	10.00	0.133	1.12	0.149	1.60	1.330	0.830
	Screen	Fixed	5	6825	8.73	9.00	0.046	1.06	0.049	1.60	0.459	0.055
	Screen	Fixed	5	6985	8.83	9.00	0.046	1.04	0.048	1.60	0.455	0.153
Note 1	Bottom	Fixed	0	6345	9.76	10.00	0.037	1.06	0.039	1.60	0.375	0.222
Antenna: Chain 1 (Main)												
	Screen	Fixed	5	6185	9.83	10.00	0.134	1.04	0.139	1.60	1.340	0.743
	Screen	Fixed	5	6345	10.03	10.50	0.165	1.11	**0.184**	1.60	1.650	1.080
	Screen	Fixed	5	6505	9.83	10.00	0.118	1.04	0.123	1.60	1.180	0.642
	Screen	Fixed	5	6825	8.85	9.00	0.034	1.04	0.035	1.60	0.342	0.031
	Screen	Fixed	5	6985	9.12	9.50	0.033	1.09	0.036	1.60	0.329	0.013
	Bottom	Fixed	0	6345	10.03	10.50	0.026	1.11	0.029	1.60	0.262	0.204

Note: 1. We only presented the worst plots for each test configuration.
2. For reference purposes only, not specifically for compliance,

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Test SKU: SKU #2 (with LUXSHARE-ICT Antenna)

Liquid Temperature : 21.0℃											Depth of Liquid:＞15cm	
Test Mode: WIFI 6E												
Remark	Test Position: Body	Antenna Position	Separation Distance (mm)	Freque-ncy	Conducted Power (dBm)	Maximum Tune-up (dBm)	SAR 1g (W/kg)	Scale Factor	Scale SAR	Limit (W/kg)	Estimated epithial APD Note 2	
											1 cm^2	4 cm^2
802.11ax-HE160												
Antenna: Chain 0 (AUX)												
Note 1	Screen	Fixed	5	6185	9.80	10.00	0.192	1.05	**0.201**	1.60	1.920	1.380
	Screen	Fixed	5	6345	9.76	10.00	0.170	1.06	0.180	1.60	1.700	1.160
	Screen	Fixed	5	6505	9.50	10.00	0.155	1.12	0.174	1.60	1.550	1.040
	Screen	Fixed	5	6825	8.73	9.00	0.076	1.06	0.081	1.60	0.756	0.425
	Screen	Fixed	0.5	6985	8.83	9.00	0.033	1.04	0.034	1.60	0.328	0.159
Note 1	Bottom	Fixed	5	6185	9.76	10.00	0.053	1.06	0.056	1.60	0.528	0.256
Antenna: Chain 1 (Main)												
	Screen	Fixed	5	6185	9.83	10.00	0.174	1.04	**0.181**	1.60	1.740	1.160
	Screen	Fixed	5	6345	10.03	10.50	0.151	1.11	0.168	1.60	1.510	0.948
	Screen	Fixed	5	6505	9.83	10.00	0.138	1.04	0.144	1.60	1.380	0.935
	Screen	Fixed	5	6825	8.85	9.00	0.063	1.04	0.065	1.60	0.632	0.317
	Screen	Fixed	5	6985	9.12	9.50	0.290	1.09	0.317	1.60	0.293	0.142
	Bottom	Fixed	0	6185	10.03	10.50	0.044	1.11	0.049	1.60	0.443	0.239

Note: 1. We only presented the worst plots for each test configuration.
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10.2. Power Density Test Result

Test Date	2022. 02. 23	Temp./Hum.	21℃/42%
Test Voltage	AC 120V, 60Hz (with AC Adapter)	Tested by	Sean Wang

Test SKU: SKU #1 (with INAPQ Antenna)

Test Mode: WIFI 6E								
Test Position: Body	Antenna Position	Separation Distance (mm)	Frequency	Uncertainty Cor.Factor Note1	Scale Factor	Pstot (W/m^2) $4cm^2$	C-PStot avg Note2 (W/m^2) $4cm^2$	Limit (W/m^2) $4cm^2$
802.11ax-HE160								
Antenna: Chain 0 (ANT 1-AUX)								
Screen	Fixed	2	6025	1.12	1.03	3.070	3.542	10.00
Screen	Fixed	2	6345	1.12	1.06	1.660	1.971	10.00
Screen	Fixed	2	6505	1.12	1.12	2.340	2.935	10.00
Screen	Fixed	2	6825	1.12	1.06	3.550	**4.215**	10.00
Screen	Fixed	2	6985	1.12	1.04	0.366	0.426	10.00
Antenna: Chain 1 (ANT 2-Main)								
Screen	Fixed	2	6025	1.12	1.07	1.030	1.234	10.00
Screen	Fixed	2	6345	1.12	1.11	1.440	1.790	10.00
Screen	Fixed	2	6505	1.12	1.04	1.700	1.980	10.00
Screen	Fixed	2	6825	1.12	1.04	0.965	1.124	10.00
Screen	Fixed	2	6985	1.12	1.09	0.897	1.095	10.00

Note 1: The correction factor uncertainty in dB corresponds to the difference between the actual uncertainty and the 30% target value, as per the TCB Workshop April. 2021.
Per IEC 62479:2010, actual uncertainty is 1.52 dB(42%) so the correction factor is 0.7 + 0.42 = 1.12.

Note 2: C-PStot = Compensated PStot.

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Test SKU: SKU #2 (with LUXSHARE-ICT Antenna)

Test Mode: WIFI 6E								
Test Position: Body	Antenna Position	Separation Distance (mm)	Frequency	Uncertainty Cor.Factor Note1	Scale Factor	PStot avg (W/m^2) $4cm^2$	C-PStot avg Note2 (W/m^2) $4cm^2$	Limit (W/m^2) $4cm^2$
802.11ax-HE160								
Antenna: Chain 0 (ANT 1-AUX)								
Screen	Fixed	2	6025	1.12	1.03	3.700	4.268	10.00
Screen	Fixed	2	6345	1.12	1.06	2.540	3.015	10.00
Screen	Fixed	2	6505	1.12	1.12	2.880	3.613	10.00
Screen	Fixed	2	6825	1.12	1.06	0.791	0.939	10.00
Screen	Fixed	2	6985	1.12	1.04	0.771	0.898	10.00
Antenna: Chain 1 (ANT 2-Main)								
Screen	Fixed	2	6025	1.12	1.07	5.490	**6.579**	10.00
Screen	Fixed	2	6345	1.12	1.11	3.240	4.028	10.00
Screen	Fixed	2	6505	1.12	1.04	0.892	1.039	10.00
Screen	Fixed	2	6825	1.12	1.04	1.820	2.120	10.00
Screen	Fixed	2	6985	1.12	1.09	1.450	1.770	10.00

Note 1: The correction factor uncertainty in dB corresponds to the difference between the actual uncertainty and the 30% target value, as per the TCB Workshop Oct. 20.
Per IEC 62479:2010, actual uncertainty is 1.52 dB(42%) so the correction factor is 0.7 + 0.42 = 1.12.

Note 2: C-PStot = Compensated PStot.

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APPENDIX A

GRAPH RESULT

(Model: 15Z90Q)

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APPENDIX B

TEST PHOTOGRAPHS

(Model: 15Z90Q)

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APPENDIX C

Test Equipment Calibration Data