Audix Technology Corp.
No. 53-11, Dingfu, Linkou, Dist.,
New Taipei City244,Taiwan

Tel: +886 2 26099301
Fax: +886 2 26099303

FCC 2.1093
SAR Test Report

for

LG Electronics Inc.

222, LG-ro Jinwi-myeon, Pyeongtaek-Si, Gyeonggi-Do, 451-713, Korea

Product Name	**:**	**Notebook Computer**
Model Name	**:**	**(1)17Z990 (2)17ZD990 (3)17ZB990 (4)17ZG990 (5)LG17Z99**
Brand		**LG**
FCC ID	**:**	**BEJNT-17Z990**

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

Testing Laboratory
1724

TESTING
NVLAP LAB CODE 200077-0

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 CERTIFICATION

Applicant	:	LG Electronics Inc.
Factory	:	LG Electronics Nanjing New Technology Co., Ltd.
EUT Description		
(1) Product	:	Notebook Computer
(2) Model	:	(1)17Z990 (2)17ZD990 (3)17ZB990 (4)17ZG990 (5)LG17Z99
(3) Brand	:	LG
(4) Power Supply	:	DC 19V, 2.53A

Applicable Standards:

47CFRFCC Part 2(§2.1093)
IEEE 1528-2013

KDB 248227 D01 802.11 Wi-Fi SAR v02r02
KDB 447498 D01 General RF Exposure Guidance v06
KDB 865664 D01 SAR Measurement 100MHz to 6GHz v01r04
KDB 616217 D04 SAR for laptop and tablets v01r02

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: 2018. 10. 30

Reviewed by: (Tina Huang/Administrator)

Approved by: (Ben Cheng/Manager)

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1. REVISION RECORD OF TEST REPORT

Edition No	Issued Date	Revision Summary	Report Number
0	2018. 10. 31	Original Report	EM-SR180023

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2. SUMMARY OF TEST RESULTS

Mode		Highest Reported Body SAR $_{1g}$	Scale SAR_{1g}
WLAN 2.4G (802.11b)	ANT: Main	**0.214(W/kg)**	**0.237(W/kg)**
	ANT: AUX	**0.178(W/kg)**	**0.198(W/kg)**
WLAN 2.4G (802.11n)	ANT: Main	**0.172(W/kg)**	**0.187(W/kg)**
	ANT: AUX	**0.185(W/kg)**	**0.202(W/kg)**
WLAN 5G (802.11a)	ANT: Main	**0.500(W/kg)**	**0.505(W/kg)**
	ANT: AUX	**0.313(W/kg)**	**0.340(W/kg)**
WLAN 5G (802.11n)	ANT: Main	**0.434(W/kg)**	**0.469(W/kg)**
	ANT: AUX	**0.372(W/kg)**	**0.402(W/kg)**
BT	ANT: Main	**0.084(W/kg)**	**0.091 (W/kg)**
Note: The SAR limit (SAR1g 1.6 W/kg) for general population / uncontrolled exposure is specified in FCC 47 CFR part 2 (2.1093).			

Highest Simultaneous Transmission SAR	Scale SAR_{1g}
WLAN 2.4G ANT Main+ WLAN 2.4G ANT AUX	0.389 (W/kg)
WLAN 2.4G ANT AUX+ BT ANT Main	0.289 (W/kg)
WLAN 5G ANT AUX+ BT ANT Main	0.431 (W/kg)
WLAN 5G ANT Main+ WLAN 5 ANT AUX	0.871 (W/kg)
WLAN 5G ANT Main+ WLAN 5 ANT AUX + BT ANT Main	0.962 (W/kg)
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.	

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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 451-713 Korea.
Manufacturer	LG Electronics Nanjing New Technology Co., Ltd. No.346,Yaoxin Road, Economic & Technical Development Zone, Nanjing, China.
Product	Notebook Computer
Brand	LG
Model	(1)17Z990 (2)17ZD990 (3)17ZB990 (4)17ZG990 (5)LG17Z99 The difference between all models is different in the sales customers.

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3.2. Description of EUT

<table>
<tr><td>Test Model</td><td>17Z990</td></tr>
<tr><td>Serial Number</td><td>N/A</td></tr>
<tr><td>Power Rating</td><td>DC 19V, 2.53A</td></tr>
<tr><td>RF Features</td><td>WLAN:802.11a/b/g/n/ac
Bluetooth: BT and BLE</td></tr>
<tr><td>Transmit Type</td><td>
<table>
<tr><th colspan="2">2.4 GHz</th></tr>
<tr><td>802.11b</td><td>1T1R</td></tr>
<tr><td>802.11g</td><td>1T1R</td></tr>
<tr><td>802.11n-HT20</td><td>2T2R</td></tr>
<tr><td>802.11n-HT40</td><td>2T2R</td></tr>
<tr><td>BT/BLE</td><td>1T1R</td></tr>
</table>
<table>
<tr><th colspan="2">UNII Bands</th></tr>
<tr><td>802.11a</td><td>1T1R</td></tr>
<tr><td>802.11n-HT20/
802.11ac-VHT20</td><td>2T2R</td></tr>
<tr><td>802.11n-HT40/
802.11ac-VHT40</td><td>2T2R</td></tr>
<tr><td>802.11ac-VHT80</td><td>2T2R</td></tr>
<tr><td>802.11ac-VHT160</td><td>2T2R</td></tr>
</table>
</td></tr>
<tr><td>Sample Status</td><td>Production</td></tr>
<tr><td>Date of Receipt</td><td>2018. 10. 15</td></tr>
<tr><td>Date of Test</td><td>2018. 10. 27 ~ 30</td></tr>
<tr><td>Interface Ports of EUT</td><td>• One Micro SD Card Slot
• One Earphone Port
• Three USB 3.0 Ports
• One USB Type C Port
• One HDMI Port
• One DC Input Port</td></tr>
<tr><td>Accessories Supplied</td><td>• AC Adapter
• LAN Gender</td></tr>
</table>

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3.4. Antenna Information

2.4G Antenna					
No.	Antenna Part Number	Manufacture	Antenna Type	Frequency (MHz)	Max Gain (dBi)
1	WA-F-LBLB-04-064 (Main)	INPAQ	FPCB	2400	1.57
				2450	1.41
				2500	1.55
2	WA-F-LBLB-04-064 (AUX)	INPAQ	FPCB	2400	1.81
				2450	1.07
				2500	1.79

5G Antenna					
No.	Antenna Part Number	Manufacture	Antenna Type	Frequency (MHz)	Max Gain (dBi)
1	WA-F-LBLB-04-064 (Main)	INPAQ	FPCB	5100	2.85
				5400	3.13
				5800	3.19
2	WA-F-LBLB-04-064 (AUX)	INPAQ	FPCB	5100	3.09
				5400	3.02
				5800	2.66

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3.5. EUT Specifications Assessed in Current Report

2.4GHz		
Mode	Fundamental Range (MHz)	Channel Number
802.11b	2412-2472	13
802.11g		13
802.11n-HT20		13
802.11n-HT40	2422-2462	9
Bluetooth	2402-2480	79
BLE	2402-2480	40

Mode	UNII Band	Fundamental Range (MHz)	Channel Number
802.11a	I	5180-5240	4
	II-2A	5260-5320	4
	II-2C	5500-5700	11
	III	5745-5825	5
802.11n-HT20/ 802.11ac-VHT20	I	5180-5240	4
	II-2A	5260-5320	4
	II-2C	5500-5720	12
	III	5745-5825	5
802.11n-HT40/ 802.11ac-VHT40	I	5190-5230	2
	II-2A	5270-5310	2
	II-2C	5510-5710	6
	III	5755-5795	2
802.11ac-VHT80	I	5210	1
	II-2A	5290	1
	II-2C	5530-5690	3
	III	5775	1
802.11ac-VHT160	I	5250	1
	II-2C	5570	1
Remark: UNII Band II-2A and II-2C (DFS Function, Slave/no In service monitor, no Ad-Hoc mode)			

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Mode	Modulation	Data Rate (Mbps)
802.11b	DSSS (DBPSK/DQPSK/CCK)	Up to 11
802.11g	OFDM (BPSK/QPSK/16QAM/64QAM)	Up to 54
802.11a		Up to 54
802.11n-HT20	OFDM (BPSK/QPSK/16QAM/64QAM)	Up to 144.4
802.11n-HT40		Up to 300
802.11ac-VHT20	OFDM (BPSK/QPSK/16QAM/64QAM/256QAM)	Up to 173.3
802.11ac-VHT40		Up to 400
802.11ac-VHT80		Up to 866.7
802.11ac-VHT160		Up to 1733.3
Bluetooth	FHSS (GFSK, π/4 DQPSK, 8-DPSK)	1/2/3
BLE	GFSK	1

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3.7. Description of Key Components

3.7.1. For the All Component Lists

Item	Supplier	Model / Type	Character
System	Microsoft	Win10 Home	---
	Microsoft	Win10 Pro	---
Main Board	LG	PRIME Main B/D PCB	(without Thunderbolt) Manufacturer: #1 Hannstar Board Tech (Jiang Yin) Corp., Ltd. #2 Elec & Eltek Company (MCO) Limited
	LG	PRIME Main B/D PCB	(with Thunderbolt) Manufacturer: #1 Hannstar Board Tech (Jiang Yin) Corp., Ltd. #2 Elec & Eltek Company (MCO) Limited.
SUB Board	LG	PRIME SUB B/D	(with Finger Printer Manufacturer: #1 Hannstar Board Tech (Jiang Yin) Corp., Ltd. #2 Elec & Eltek Company (MCO) Limited.
	LG	PRIME SUB B/D	(withoutFinger Printer) Manufacturer: #1 Hannstar Board Tech (Jiang Yin) Corp., Ltd. #2 Elec & Eltek Company (MCO) Limited.
CPU (Socket: BGA1528)	Intel	i7-8565U	1.8GHz, up to 4.6GHz
	Intel	i5-8265U	1.6GHz, up to 3.9GHz
	Intel	I3-8145U	2.1GHz, up to 3.9GHz
17" LCD Panel	LG Display	LP170WQ1(SP)(A1)	Resolution: 2560 x 1600, 60Hz WQXGA IPS (Normal Non touch)
Storage (SSD)	Samsung	MZ-VLB5120 (P/N MZVLB512HAJQ-0000)	512GB (NVMe)
		MZ-NLN128C (P/N MZNLN128HAHQ-0000)	128GB (SATA)
	SK hynix	P/N HFS256G39TNF	256GB (SATA)
		P/N HFS512G39TNF	512GB (SATA)

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Item	Supplier	Model / Type	Character
Memory (RAM)	Samsung	K4AAG16 5WB MCRC	8GB DDR4 (On Board)
		K4A8G16 5WC-BCTD	4GB DDR4 (On Board)
	SK hynix	H5ANAG6NAMR	8GB DDR4 (On Board)
		H5AN8G6NAFR	4GB DDR4 (On Board)
	Samsung	M471A5244CB0-CRC	4GB DDR4SODIMM(on Card)
		M471A5244CB0-CTD	4GB DDR4 SODIMM(on Card)
		M471A1K43CB1-CTD	8GB DDR4 SODIMM (on Card)
		M471A1K43CB1-CRC	8GB DDR4 SODIMM (on Card)
	SK hynix	HMA81GS6AFR8N-UH	8GB DDR4 SODIMM (on Card)
		HMA851S6AFR6N-UH	4GB DDR4 SODIMM (on Card)
Battery Pack	LG	LBS1224E	72Wh, DC7.7V, 9450mAh
WLAN Combo Card	Intel	9560D2W	802.11a/b/g/n/ac 2.4GHz/5GHz + BT+BLE 5.0
WLAN Combo Antenna	LG (INPAQ)	WA-F-LBLB-04-064	FPCB Type Main: Black, Aux: Gray
Keyboard	LG	SN3870BL	17Z990 Black KBD
		SN3870BL1	17Z990 White KBD
Web Camera	Chicony	CKFIH2821005290LH	With two microphones
		CKFIH28-121005290LH	With One microphone
	Luxvisions	7BF109N2DC	With two microphones
		7BF109N2DD	With One microphone
Finger Print	SUNTEL	SFPA-L002STA(White)	---
	SUNTEL	SFPA-L002STB(Black)	---
LAN Gender (Type C to LAN)	SUZHOU MEC ELECTRONICS	80-5946-111 (White)	10/100 Megabit Ethernet
		80-5946-101 (Black)	
	ARIN TECH CO. LTD	GD-08MF-36-WH-LP10 (White)	10/100 Megabit Ethernet
		GD-08MF-36-BK-LP11 (Black)	
	Type C to LAN: Shielded, Undetached, 0.12m		
AC Adapter (48W)	LG (HONOR)	ADS-48MS-19-2 19048E	I/P: AC 100-240V, 50-60Hz, 1.5A, O/P: DC 19V, 2.53A
	DC Power Cord: Non-Shielded, Undetached, 1.8m 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.

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

SKU	
Main Board	LG, PRIME Main B/D PCB (with Thunderbolt)
SUB Board	LG, PRIME Main B/D PCB (with Finger Printer)
CPU	Intel, i7-8565U
17” LCD Panel	LP170WQ1(SP)(A1) (Normal Non touch)
Storage (SSD)	Samsung, 512GB (NVMe)
	Samsung, 128GB (SATA)
Memory (RAM)	Samsung, 8GB (On Board)
	Samsung, 8GB (On Card)
Battery Pack	LG, LBS1224E
WLAN Combo Card	Intel, 9560D2W
WLAN Combo Antenna	LG (INPAQ), WA-F-LBLB-04-064
Keyboard	LG, SN3870BL
Web Camera	Chicony, CKFIH2821005290LH
Finger Print	SUNTEL, SFPA-L002STA(White)
LAN Gender (Type C to LAN)	SUZHOU MEC ELECTRONICS, 80-5946-111 (White)
AC Adapter	LG (HONOR), ADS-48MS-19-2 19048E

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3.8. Test Environment

Ambient conditions in the laboratory:

Item	Require	Actual
Temperature (℃)	18-25	22 ±2
Humidity (%RH)	30-70	48 ± 2

3.9. Description of Test Facility

Name of Test Firm	Audix Technology Corporation / EMC Department No. 53-11, Dingfu, Linkou Dist., New Taipei City 244, Taiwan 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 17025:2005 (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 (1) SAR Room

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3.10.Measurement Uncertainty

DASY5 Uncertainty According to IEEE 1528-2013 and IEC 62209-1/2016 (0.3 - 6 GHz range)								
Error Description	Uncert. value	Prob. Dist.	Div.	(c_i) 1g	(c_i) 10g	Std. Unc. (1g)	Std. Unc. (10g)	(v_i) v_{eff}
Measurement System								
Probe Calibration	±6.0%	N	1	1	1	±6.0%	±6.0%	∞
Axial Isotropy	±4.7%	R	$\sqrt{3}$	0.7	0.7	±1.9%	±1.9%	∞
Hemispherical Isotropy	±9.6%	R	$\sqrt{3}$	0.7	0.7	±3.9%	±3.9%	∞
Boundary Effects	±1.0%	R	$\sqrt{3}$	1	1	±0.6%	±0.6%	∞
Linearity	±4.7%	R	$\sqrt{3}$	1	1	±2.7%	±2.7%	∞
System Detection Limits	±1.0%	R	$\sqrt{3}$	1	1	±0.6%	±0.6%	∞
Readout Electronics	±0.3%	N	1	1	1	±0.3%	±0.3%	∞
Response Time	±0.8%	R	$\sqrt{3}$	1	1	±0.5%	±0.5%	∞
Integration Time	±2.6%	R	$\sqrt{3}$	1	1	±1.5%	±1.5%	∞
RF Ambient Noise	±3.0%	R	$\sqrt{3}$	1	1	±1.7%	±1.7%	∞
RF Ambient Reflections	±3.0%	R	$\sqrt{3}$	1	1	±1.7%	±1.7%	∞
Probe Positioner	±0.4%	R	$\sqrt{3}$	1	1	±0.2%	±0.2%	∞
Probe Positioning	±2.9%	R	$\sqrt{3}$	1	1	±1.7%	±1.7%	∞
Max. SAR Eval.	±1.0%	R	$\sqrt{3}$	1	1	±0.6%	±0.6%	∞
Test Sample Related								
Device Positioning	±2.9%	N	1	1	1	±2.9%	±2.9%	145
Device Holder	±3.6%	N	1	1	1	±3.6%	±3.6%	5
Power Drift	±5.0%	R	$\sqrt{3}$	1	1	±2.9%	±2.9%	∞
Phantom and Setup								
Phantom Uncertainty	±4.0%	R	$\sqrt{3}$	1	1	±2.3%	±2.3%	∞
Liquid Conductivity (target)	±5.0%	R	$\sqrt{3}$	0.64	0.43	±1.8%	±1.2%	∞
Liquid Conductivity (meas.)	±2.5%	N	1	0.64	0.43	±1.6%	±1.1%	∞
Liquid Permittivity (target)	±5.0%	R	$\sqrt{3}$	0.6	0.49	±1.7%	±1.4%	∞
Liquid Permittivity (meas.)	±2.5%	N	1	0.6	0.49	±1.5%	±1.2%	∞
Combined Std. Uncertainty						±11%	±10.8%	387
Expanded STD Uncertainty						±22%	±21.5%	

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DASY5 Uncertainty

According to IEC 62209-2/2010 (30 MHz - 6 GHz range)

Error Description	Uncert. value	Prob. Dist.	Div.	(c_i) 1g	(c_i) 10g	Std. Unc. (1g)	Std. Unc. (10g)	(v_i) v_{eff}
Measurement System								
Probe Calibration	±6.0%	N	1	1	1	±6.0%	±6.0%	∞
Axial Isotropy	±4.7%	R	√3	0.7	0.7	±1.9%	±1.9%	∞
Hemispherical Isotropy	±9.6%	R	√3	0.7	0.7	±3.9%	±3.9%	∞
Boundary Effects	±1.0%	R	√3	1	1	±0.6%	±0.6%	∞
Linearity	±4.7%	R	√3	1	1	±2.7%	±2.7%	∞
System Detection Limits	±1.0%	R	√3	1	1	±0.6%	±0.6%	∞
Readout Electronic	±0.3%	N	1	1	1	±0.3%	±0.3%	∞
Response Time	±0.8%	R	√3	1	1	±0.5%	±0.5%	∞
Integration Time	±2.6%	R	√3	1	1	±1.5%	±1.5%	∞
RF Ambient Noise	±3.0%	R	√3	1	1	±1.7%	±1.7%	∞
RF Ambient Reflections	±3.0%	R	√3	1	1	±1.7%	±1.7%	∞
Probe Positioner	±0.4%	R	√3	1	1	±0.2%	±0.2%	∞
Probe Positioning	±2.9%	R	√3	1	1	±1.7%	±1.7%	∞
Modulation Response	±2.5%	R	√3	1	1	±1.45 %	±1.45 %	∞
Post-processing	±3.8%	R	√3	1	1	±2.2%	±2.2%	∞
Test Sample Related								
Test Sample Positioning	±2.9%	N	1	1	1	±2.9%	±2.9%	145
Device Holder	±3.6%	N	1	1	1	±3.6%	±3.6%	5
Power Drift	±5.0%	R	√3	1	1	±2.9%	±2.9%	∞
Power Scaling	±0.0%	R	√3	1	1	±0.0%	±0.0%	∞
Phantom and Setup								
Phantom Uncertainty	±4.5%	R	√3	1	1	±2.4%	±2.4%	∞
SAR correction	±1.9%	R	√3	1	0.84	±1.9%	±1.9%	∞
Liquid Conductivity (target)	±5.0%	R	√3	0.64	0.43	±1.8%	±1.2%	∞
Liquid Conductivity (mea.)DAK	±2.5%	R	√3	0.64	0.43	±0.9%	±0.6%	∞
Liquid Permittivity (target)	±5.0%	R	√3	0.6	0.49	±1.7%	±1.4%	∞
Liquid Permittivity(mea.)DAK	±2.5%	R	√3	0.6	0.49	±0.9%	±0.7%	∞
Combined Std. Uncertainty						±11.0%	±10.9%	387
Expanded STD Uncertainty						±22.1%	±21.8%	

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Fax: +886 2 26099303

4. MEASUREMENT EQUIPMENTLIST

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Stäubli Robot TX90 XL	Stäubli	TX90	F12/5K9SA1/A101	N/A	N/A
2.	Controller	SPEAG	CS8c	N/A	N/A	N/A
3.	SAM Twin Phantom	SPEAG	N/A	1706	N/A	N/A
4.	ELI5 Phantom	SPEAG	N/A	1170	N/A	N/A
5.	Device Holder	SPEAG	N/A	N/A	N/A	N/A
6.	Data Acquisition Electronic	SPEAG	DAE4	1337	2018. 09. 19	1 Year
7.	E-Field Probe	SPEAG	EX3DV4	3855	2018. 09. 27	1 Year
8.	SAR Software	SPEAG	DASY52	V.52.8.8.1222	N/A	N/A
9.	ENA Network Analyzer	Agilent	E5071C	Y46214331	2018. 09. 21	1 Year
10.	Signal Generator	Aglient	N5181A	MY50143917	2018. 09. 12	1 Year
11.	Power Meter	Aglient	ML2487A	6K00005406	2018. 05. 02	1 Year
12.	Power Sensor	Aglient	N8481H	MY52080006	2018. 09. 11	1 Year
13.	Dipole Antenna	SPEAG	D2450V2	888	2018. 09. 27	3 Years
14.	Dipole Antenna	SPEAG	D5GHzV2	1124	2018. 09. 27	3 Years

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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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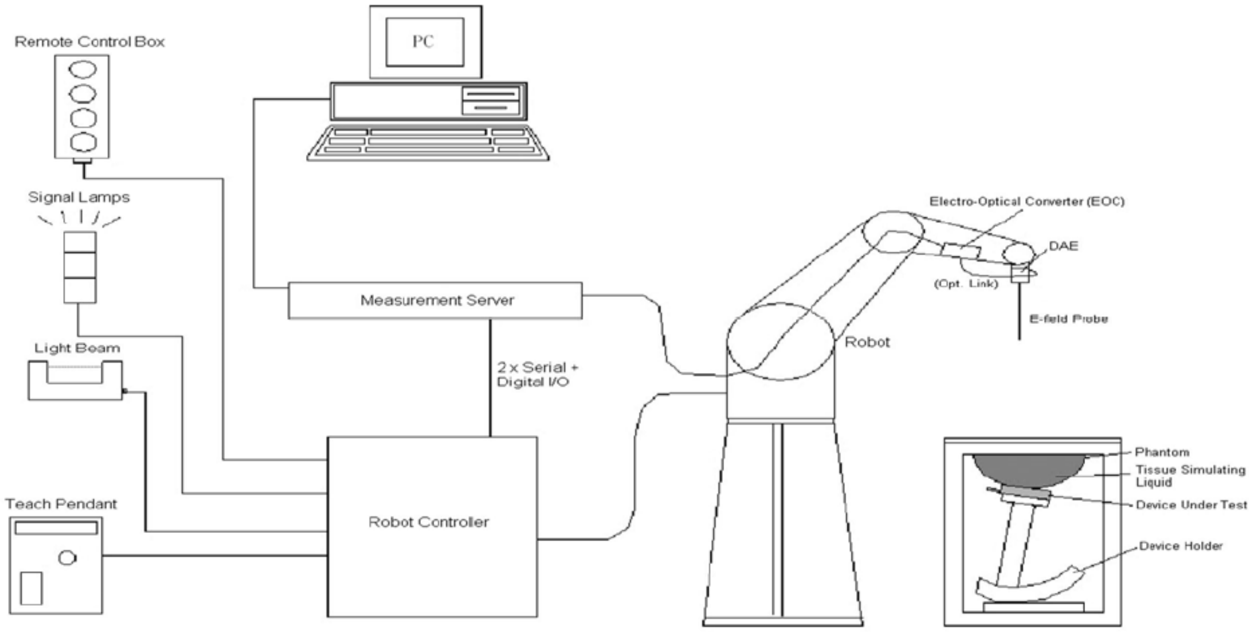
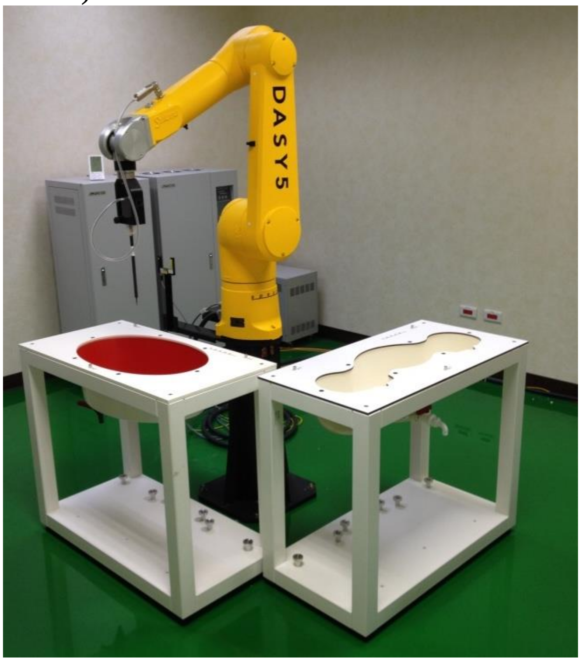


Fig-3.1 DASY System Setup

5.2.1. Robot

The DASY system uses the high precision robots from Stäubli SA (France). For the 6-axis controller system, the robot controller version (DASY5: 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	Ex3DV4	
Construction	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)	
Frequency	10 MHz to 6 GHz Linearity: ± 0.2 dB	
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)	
DynamicRange	10 µW/g to 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	

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.	
MeasurementRange	-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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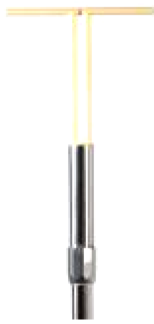
5.2.5. Device Holder

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 5800 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.

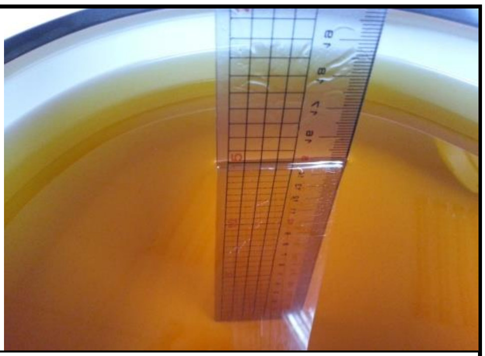

Photo of Liquid Height

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 85070D 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%
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

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Table-5.2 Recipes of Tissue Simulating Liquid

Tissue Type	Bactericide	DGBE	HEC	NaCI	Sucrose	Triton X-100	Water	Diethylene Glycol Mono-hexylether
For Head								
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
For Body								
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

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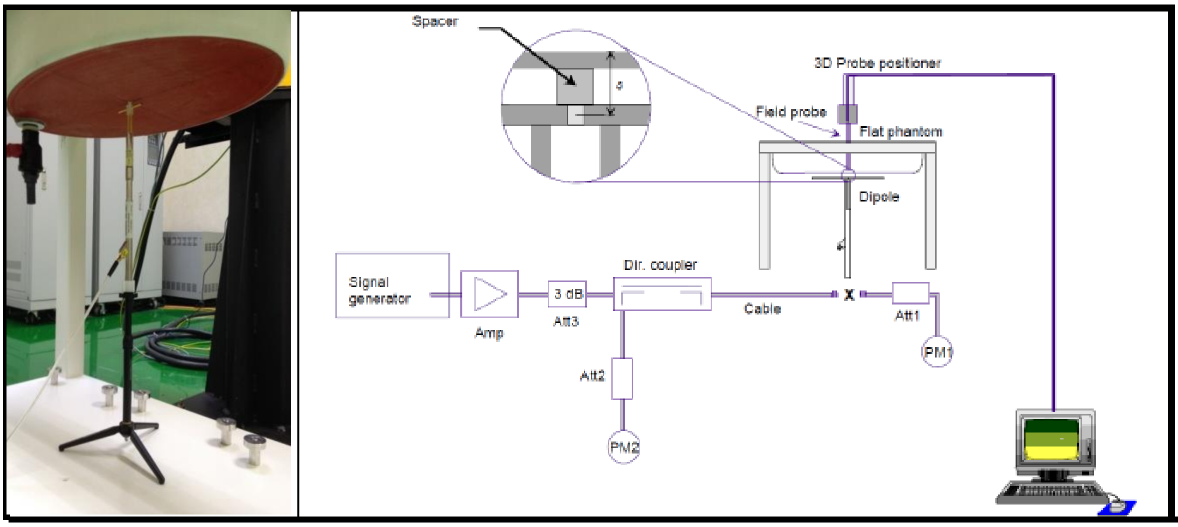
5.3. SAR System Verification

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 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

System Performance Check at WLAN

Dipole Kit: D2450V2(Body)

Frequency [MHz]	Description	SAR [w/kg] 1g			SAR [w/kg] 10g			Tissue Temp. [℃]
2450MHz	Reference result	51.2			24.0			N/A
	± 10% window	46.080	to	56.320	21.600	to	26.400	
	2018. 10. 27	51.20			23.88			22.1

Note: All SAR values are normalized to 1W forward power.

System Performance Check at WLAN

Dipole Kit: D5GHzV2 (Body)

Frequency [MHz]	Description	SAR [w/kg] 1g			SAR [w/kg] 10g			Tissue Temp. [℃]
5300MHz	Reference result	76.9			21.5			N/A
	± 10% window	69.210	to	84.590	19.350	to	23.650	
	2018. 10. 28	74.40			21.30			22.2

Note: All SAR values are normalized to 1W forward power.

System Performance Check at WLAN

Dipole Kit: D5GHzV2 (Body)

Frequency [MHz]	Description	SAR [w/kg] 1g			SAR [w/kg] 10g			Tissue Temp. [℃]
5600MHz	Reference result	80.6			22.4			N/A
	± 10% window	72.540	to	88.660	20.160	to	24.640	
	2018. 10. 29	87.60			23.90			22.1

Note: All SAR values are normalized to 1W forward power.

System Performance Check at WLAN

Dipole Kit: D5GHzV2 (Body)

Frequency [MHz]	Description	SAR [w/kg] 1g			SAR [w/kg] 10g			Tissue Temp. [℃]
5800MHz	Reference result	77.1			21.2			N/A
	± 10% window	69.390	to	84.810	19.080	to	23.320	
	2018. 10. 30	83.50			22.90			22.1

Note: All SAR values are normalized to 1W forward power.

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5.3.2. SAR System Check Data

Date: 10/27/2018

Test Laboratory: Audix_SAR Lab

System Check_B2450

DUT: D2450V2 - SN888; Type: D2450V2; Serial: SN888

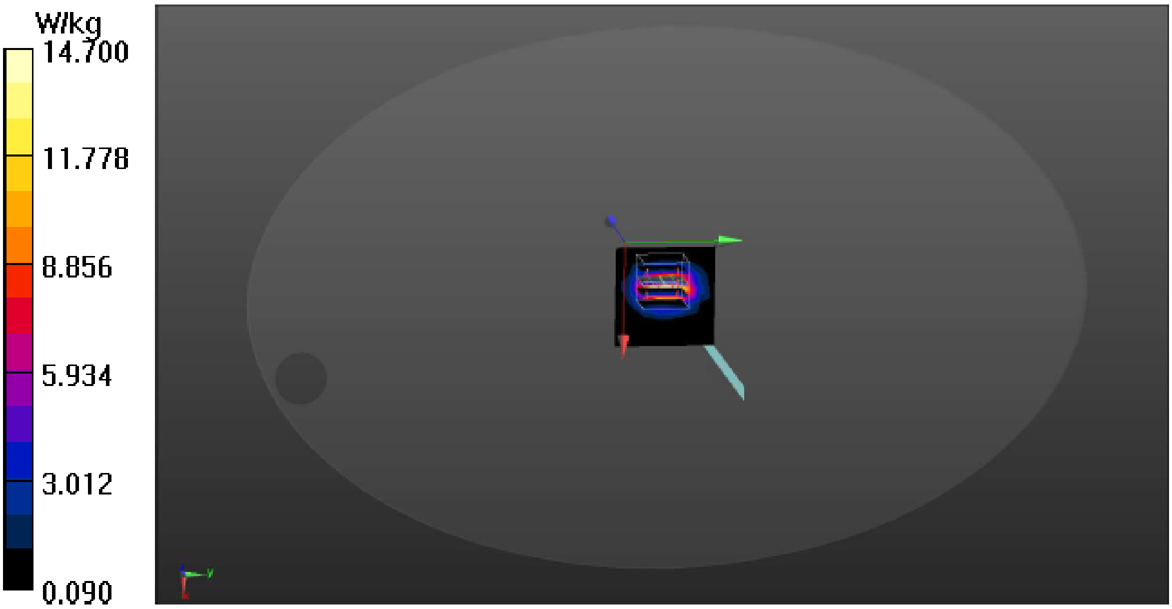
Communication System: UID 0, CW (0); Frequency: 2450 MHz;Duty Cycle:1:1
Medium parameters used: f = 2450 MHz; σ = 1.996 S/m; ε_r = 51.622; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3855; ConvF(7.67, 7.67, 7.67); Calibrated: 9/27/2018;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1337; Calibrated: 9/19/2018
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1170
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Area Scan (8x8x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 17.1 W/kg

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 72.75 V/m; Power Drift = 0.14 dB
Peak SAR (extrapolated) = 24.4 W/kg
SAR(1 g) = 12.8 W/kg; SAR(10 g) = 5.97 W/kg
Maximum value of SAR (measured) = 14.7 W/kg



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Date: 10/28/2018

Test Laboratory: Audix_SAR Lab

System Check_B5200

DUT: D5GHzV2 - SN1124; Type: D5GHzV2; Serial: SN1124

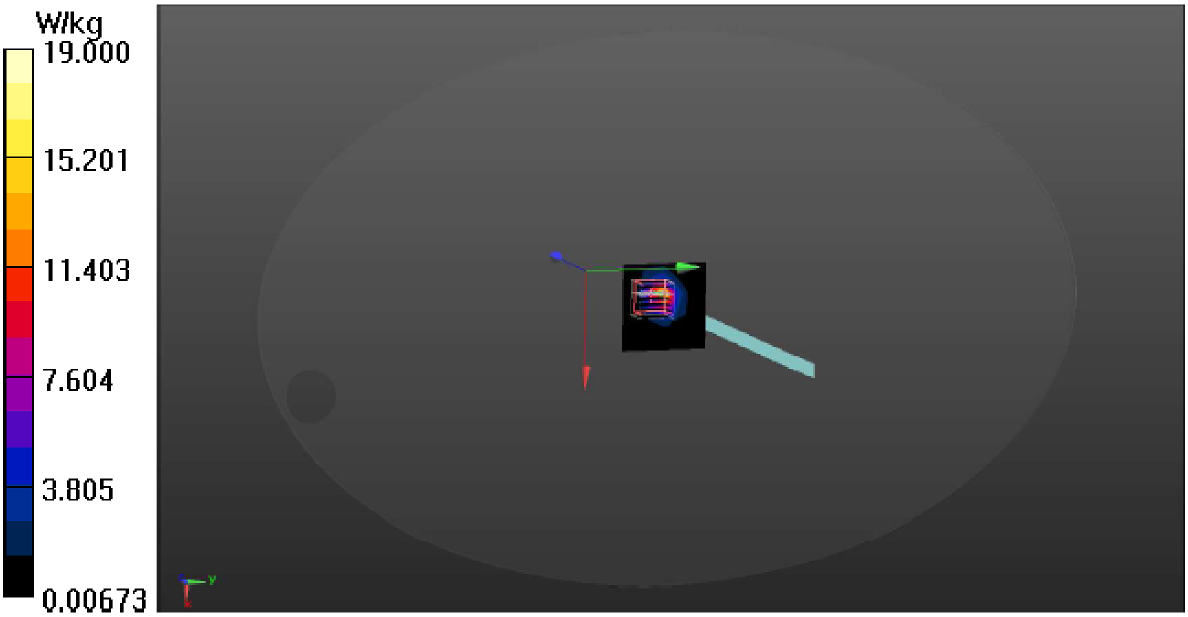
Communication System: UID 0, CW (0); Frequency: 5300 MHz;Duty Cycle:1:1
Medium parameters used: f = 5300 MHz; σ = 5.488 S/m; ε_r = 47.439; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3855; ConvF(4.37, 4.37, 4.37); Calibrated: 9/27/2018;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1337; Calibrated: 9/19/2018
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1170
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 16.4 W/kg

Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 33.24 V/m; Power Drift = 0.75 dB
Peak SAR (extrapolated) = 32.7 W/kg
SAR(1 g) = 7.44 W/kg; SAR(10 g) = 2.13 W/kg
Maximum value of SAR (measured) = 19.0 W/kg



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No. 53-11, Dingfu, Linkou, Dist.,
New Taipei City244,Taiwan

Tel: +886 2 26099301
Fax: +886 2 26099303

Date: 10/29/2018

Test Laboratory: Audix_SAR Lab

System Check_B5600

DUT: D5GHzV2 - SN1124; Type: D5GHzV2; Serial: SN1124

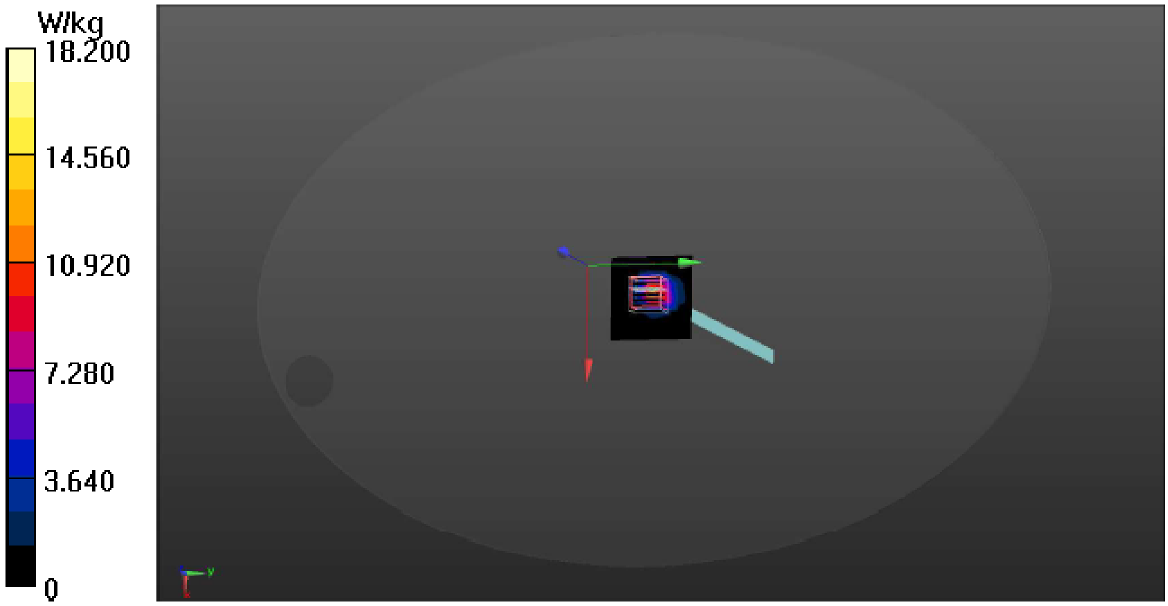
Communication System: UID 0, CW (0); Frequency: 5600 MHz;Duty Cycle:1:1
Medium parameters used: f = 5600 MHz; σ = 5.894 S/m; ε_r = 46.817; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3855; ConvF(4.07, 4.07, 4.07); Calibrated: 9/27/2018;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1337; Calibrated: 9/19/2018
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1170
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 13.3 W/kg

Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 32.45 V/m; Power Drift = 0.10 dB
Peak SAR (extrapolated) = 36.3 W/kg
SAR(1 g) = 8.76 W/kg; SAR(10 g) = 2.39 W/kg
Maximum value of SAR (measured) = 18.2 W/kg



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Fax: +886 2 26099303

Date: 10/30/2018

Test Laboratory: Audix_SAR Lab

System Check_B5800

DUT: D5GHzV2 - SN1124; Type: D5GHzV2; Serial: SN1124

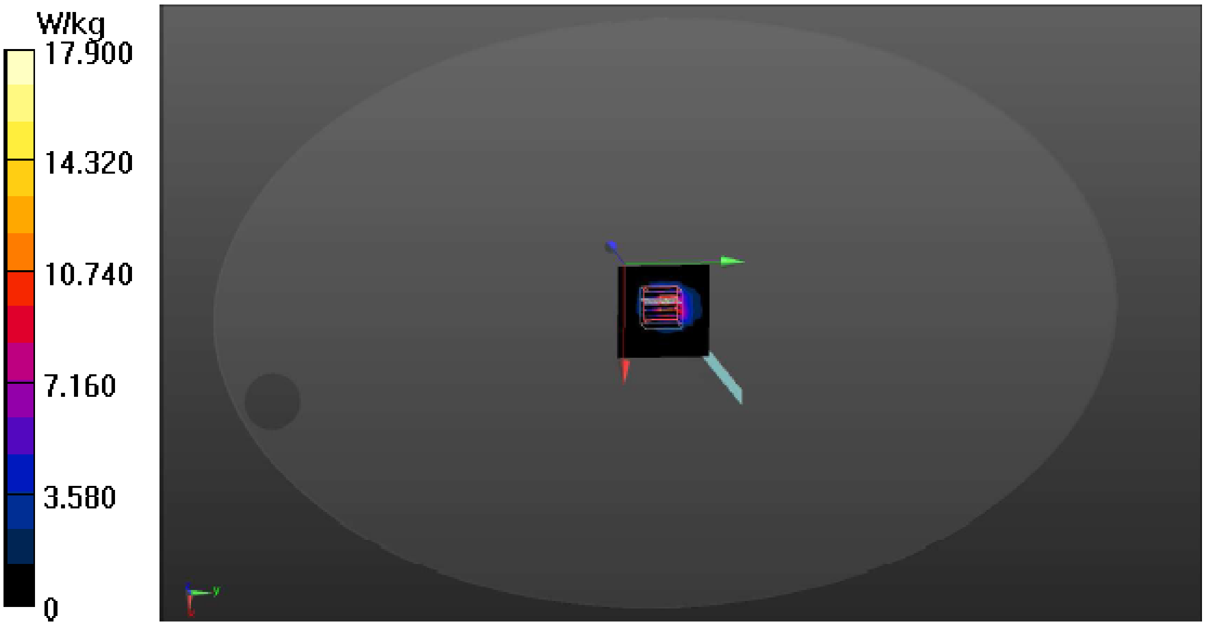
Communication System: UID 0, CW (0); Frequency: 5800 MHz;Duty Cycle:1:1
Medium parameters used: f = 5800 MHz; $\sigma = 6.172$ S/m; $\varepsilon_r = 46.486$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3855; ConvF(4.3, 4.3, 4.3); Calibrated: 9/27/2018;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1337; Calibrated: 9/19/2018
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1170
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 12.7 W/kg

Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 32.33 V/m; Power Drift = 0.21 dB
Peak SAR (extrapolated) = 34.2 W/kg
SAR(1 g) = 8.35 W/kg; SAR(10 g) = 2.29 W/kg
Maximum value of SAR (measured) = 17.9 W/kg



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New Taipei City244,Taiwan

Tel: +886 2 26099301
Fax: +886 2 26099303

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

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 865664D01v01r03, 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.

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Fax: +886 2 26099303

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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Fax: +886 2 26099303

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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Fax: +886 2 26099303

6. SAR MEASUREMENT EVALUATION

6.1. 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.

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6.2. 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
WLAN		√				

Note: Per KDB 447498 D01

a) For 100 MHz to 6 GHz and test separation distances ≤ 50 mm, the 1-g and 10-g SAR test exclusion thresholds are determined by the following:
[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR, and ≤ 7.5 for 10-g extremity SAR,30 where
- f(GHz) is the RF channel transmit frequency in GHz

b) For 100 MHz to 6 GHz and test separation distances > 50 mm, the 1-g and 10-g SAR test exclusion thresholds are determined by the following (also illustrated in Appendix B):[32]
1) {[Power allowed at numeric threshold for 50 mm in step a)] + [(test separation distance – 50 mm)·(f(MHz)/150)]} mW, for 100 MHz to 1500 MHz
2) {[Power allowed at numeric threshold for 50 mm in step a)] + [(test separation distance – 50 mm)·10]} mW, for > 1500 MHz and ≤ 6 GHz

SAR test exclusion table distance is > 50mm @ Right Side

Frequency (GHz)	In Step 1 threshold Power (mW)	Distance between antenna and user(mm)	SAR Exclusion Threshold Power @ >50 mm (mW)	EUT tune-upmaximum power (mW)	SAR test
2.437	96.0867	107.9	675.0867	141.254	No
5.230	65.5904	107.9	644.5904	120.226	No
5.270	65.3410	107.9	644.3410	152.405	No
5.690	62.8833	107.9	641.8833	183.231	No
5.795	62.3110	107.9	641.3110	223.872	No

SAR test exclusion table distance is > 50mm @ Left Side

Frequency (GHz)	In Step 1 threshold Power (mW)	Distance between antenna and user(mm)	SAR Exclusion Threshold Power @ >50 mm (mW)	EUT tune-upmaximum power (mW)	SAR test
2.437	96.0867	244.2	2038.0867	141.254	No
5.230	65.5904	244.2	2007.5904	120.226	No
5.270	65.3410	244.2	2007.3410	152.405	No
5.690	62.8833	244.2	2004.8833	183.231	No
5.795	62.3110	244.2	2004.3110	223.872	No

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6.3. 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.

Body Tissue Simulate Measurement								
Frequency [MHz]	Description	Dielectric Parameters						Tissue Temp. [℃]
		ε_r			σ[s/m]			
2450MHz	Reference result ± 5% window	52.70			1.95			N/A
		50.065	to	55.335	1.853	to	2.048	
	2018. 10. 27	51.622			1.996			22.1

Body Tissue Simulate Measurement								
Frequency [MHz]	Description	Dielectric Parameters						Tissue Temp. [℃]
		ε_r			σ[s/m]			
5300MHz	Reference result ± 5% window	48.9			5.42			N/A
		46.455	to	51.345	5.149	to	5.691	
	2018. 10. 28	47.439			5.488			22.2

Body Tissue Simulate Measurement								
Frequency [MHz]	Description	Dielectric Parameters						Tissue Temp. [℃]
		ε_r			σ[s/m]			
5600MHz	Reference result ± 5% window	48.5			5.77			N/A
		46.075	to	50.925	5.482	to	6.059	
	2018. 10. 29	46.817			5.894			22.1

Body Tissue Simulate Measurement								
Frequency [MHz]	Description	Dielectric Parameters						Tissue Temp. [℃]
		ε_r			σ[s/m]			
5800MHz	Reference result ± 5% window	48.20			6.00			N/A
		45.790	to	50.610	5.700	to	6.300	
	2018. 10. 30	46.486			6.172			22.1

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Tel: +886 2 26099301
Fax: +886 2 26099303

6.4. SAR Exposure Limits

SAR assessments have been made in line with the requirements of IEEE-1528, FCC Supplement C, and comply with ANSI/IEEE C95.1-1992 "Uncontrolled Environments" limits. These limits apply to a location which is deemed as "Uncontrolled Environment" which can be described as a situation where the general public may be exposed to an RF source with no prior knowledge or control over their exposure.

Limits for General Population/Uncontrolled Exposure (W/kg)

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

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6.5. Conducted Power Measurement

Note:

1. As per FCC OET KDB 248227 D01, conducted output power and SAR testing are not required for 802.11g/n20/n40 channels when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2W/kg.
2. When the same maximum output power is specified for both bands, begin SAR measurement in U-NII-2A band by applying the OFDM SAR requirements. If the highest reported SAR for a test configuration is ≤ 1.2 W/kg, SAR is not required for U-NII-1 band (see §B.5.2 in this document).
3. When multiple transmission modes (802.11a/g/n/ac) have the same specified maximum output power, largest channel bandwidth, lowest order modulation and lowest data rate, lowest order 802.11 mode is selected (i.e. a, g, n, then ac)
4. According to FCC OET KDB 248227 D01 v02r02, when the reported SAR of the initial test configuration is < 0.8 W/kg, SAR measurement is not required for subsequent configuration.
5. When band gap channels between UNII-2C and UNII-3 band are supported channels in UNII-2C band below 5.65 GHz are considered as one band and channels above 5.65 GHz, together with channels in 5.8 GHz U-NII-3 or §15.247 band, are considered as a separate band
6. Scale factor is applied to calculated scale SAR presented in section 6.7.
7. Scale factor not listed for channels are exempted from SAR testing.

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6.5.1. For WLAN Function

Type of Network	Channel	Frequency (MHz)	Output Power (dBm)		Max Average Output Power (dBm)	Tune-Up Limit (dBm)	Scale Factor	SAR Test
			Main	AUX				
802.11b	CH 1	2412	17.96	18.52	18.52	19.00	---	No NOTE1
	CH 6	2437	21.06	20.61	21.06	21.50	1.11	Yes
	CH 11	2462	18.19	18.74	18.74	19.00	---	No NOTE1
	CH 12	2467	13.34	14.31	14.31	14.50	---	No NOTE1
	CH 13	2472	12.16	12.80	12.80	13.00	---	No NOTE1
802.11g	CH 1	2412	16.10	16.19	16.19	16.50	---	No NOTE4
	CH 6	2437	20.49	19.57	20.49	20.50	---	No NOTE4
	CH 11	2462	16.24	16.47	16.47	16.50	---	No NOTE4
	CH 12	2467	12.11	13.25	13.25	13.50	---	No NOTE4
	CH 13	2472	-5.57	-6.47	-5.57	-5.00	---	No NOTE4

Type of Network	Channel	Frequency (MHz)	Output Power (dBm)		Total Average Output Power (dBm)	Tune-Up Limit (dBm)	Scale Factor	SAR Test
			Main	AUX				
802.11n-HT20	CH 1	2412	14.95	15.18	18.27	18.50	---	No NOTE4
	CH 6	2437	17.24	17.62	20.64	21.00	1.09	No NOTE4
	CH 11	2462	14.77	14.56	17.87	18.00	---	No NOTE4
	CH 12	2467	12.49	12.15	15.53	16.00	---	No NOTE4
	CH 13	2472	-6.08	-6.95	-3.29	-3.00	---	No NOTE4
802.11n-HT40	CH 3	2422	13.18	12.80	16.38	16.50	---	No NOTE4
	CH 6	2437	13.99	14.05	17.41	17.50	---	No NOTE4
	CH 9	2452	13.13	12.78	16.35	16.50	---	No NOTE4
	CH 10	2457	8.95	8.42	12.08	12.50	---	No NOTE4
	CH 11	2462	1.09	0.99	4.43	4.50	---	No NOTE4

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Type of Network		Channel	Frequency (MHz)	Output Power (dBm)		Max Average Output Power (dBm)	Tune-Up Limit (dBm)	Scale Factor	SAR Test
				Main	AUX				
802.11a	UNII Band I	CH 36	5180	18.43	17.55	18.43	18.50	---	No[NOTE2]
		CH 40	5200	21.11	20.47	21.11	21.50	---	No[NOTE2]
		CH 48	5240	20.53	20.55	20.55	21.00	---	No[NOTE2]
	UNII Band II-2A	CH 52	5260	20.61	20.64	20.64	21.00	1.09	Yes
		CH 60	5300	20.12	20.02	20.12	20.50	---	No[NOTE3, 4]
		CH 64	5320	17.52	17.38	17.52	18.00	---	No[NOTE3, 4]
	UNII Band II-2C	CH 100	5500	16.77	17.16	17.16	17.50		No[NOTE3, 4]
		CH 116	5580	21.01	21.26	21.26	21.50	1.06	No[NOTE3, 4]
		CH 140	5700	18.38	18.04	18.38	18.50	---	No[NOTE3, 4]
	UNII Band III	CH 149	5745	21.45	21.37	21.45	21.50	1.01	No[NOTE3, 4]
		CH 157	5785	21.17	21.09	21.17	21.50	---	No[NOTE3, 4]
		CH 165	5825	20.12	20.58	20.58	21.00	---	No[NOTE3, 4]

Type of Network		Channel	Frequency (MHz)	Output Power (dBm)		Total Average Output Power (dBm)	Tune-Up Limit (dBm)	Scale Factor	SAR Test
				Main	AUX				
802.11n-HT20	UNII Band I	CH 36	5180	15.34	16.22	19.01	19.50	---	No[NOTE2]
		CH 40	5200	18.04	18.23	21.34	21.50	---	No[NOTE2]
		CH 48	5240	17.81	18.13	21.18	21.50	---	No[NOTE2]
	UNII Band II-2A	CH 52	5260	18.21	18.37	21.50	21.50	---	No[NOTE3, 4]
		CH 60	5300	18.26	18.04	21.36	21.50	---	No[NOTE3, 4]
		CH 64	5320	15.52	15.24	18.59	19.00	---	No[NOTE3, 4]
	UNII Band II-2C	CH 100	5500	15.78	15.73	18.96	19.00	---	No[NOTE3, 4]
		CH 116	5580	18.65	17.35	21.25	21.50	1.06	Yes
		CH 140	5700	17.53	17.72	20.83	21.00	---	No[NOTE3, 4]
		CH 144	5720	17.69	17.93	21.02	21.50	---	No[NOTE3, 4]
	UNII Band III	CH 144	5720	12.14	12.39	15.47	15.50	---	No[NOTE3, 4]
		CH 149	5745	20.04	20.34	23.40	23.50	---	No[NOTE3, 4]
		CH 157	5785	19.81	20.06	23.14	23.50	---	No[NOTE3, 4]
		CH 165	5825	19.97	20.73	23.57	24.00	---	No[NOTE3, 4]

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Tel: +886 2 26099301
Fax: +886 2 26099303

Type of Network		Channel	Frequency (MHz)	Output Power (dBm)		Total Average Output Power (dBm)	Tune-Up Limit (dBm)	Scale Factor	SAR Test
				Main	Main				
802.11n-HT40	UNII Band I	CH 38	5190	13.61	13.56	16.97	17.00	---	No[NOTE2]
		CH 46	5230	17.93	16.83	20.80	21.00	---	No[NOTE2]
	UNII Band II-2A	CH 54	5270	18.27	18.61	21.83	22.00	1.04	Yes
		CH 62	5310	13.74	14.65	17.61	18.00	---	No[NOTE3, 4]
	UNII Band II-2C	CH 102	5510	12.15	12.83	15.89	16.00	---	No[NOTE3, 4]
		CH 110	5550	16.82	16.76	20.18	20.50	---	No[NOTE3, 4]
		CH 134	5670	16.95	18.26	21.04	21.50	---	No[NOTE3, 4]
		CH 142	5710	19.80	20.25	23.42	23.50	---	No[NOTE3, 4]
	UNII Band III	CH 151	5755	17.41	17.53	20.86	21.00	---	No[NOTE3, 4]
		CH 159	5795	19.74	19.85	23.18	23.50		No[NOTE3, 4]
802.11ac-VHT80	UNII Band I	CH 52	5210	8.53	9.73	12.94	13.00	---	No[NOTE2]
	UNII Band II-2A	CH 58	5290	11.19	11.63	15.18	15.50	---	No[NOTE3, 4]
	UNII Band II-2C	CH 106	5530	10.21	12.54	15.30	15.50	---	No[NOTE3, 4]
		CH 133	5610	17.45	17.24	21.11	21.50	---	No[NOTE3, 4]
		CH 138	5690	19.23	18.58	22.69	23.00	---	No[NOTE3, 4]
	UNII Band III	CH 155	5775	12.66	13.81	17.04	17.50	---	No[NOTE3, 4]

Type of Network		Channel	Frequency (MHz)	Output Power (dBm)		Total Average Output Power (dBm)	Tune-Up Limit (dBm)	Scale Factor	SAR Test
				Main	Main				
802.11ac-VHT160	UNI I	CH 50	5250	10.71	9.84	14.49	14.50	---	No[NOTE1]
	UNII Band II-2C	CH 114	5570	11.00	10.86	15.12	15.50	---	No[NOTE3, 4]

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6.5.2. For BT Function

Type of Network	Channel	Frequency (MHz)	Max Output Power (dBm)	Tune-Up Limit (dBm)	Scale Factor	SAR Test
Bluetooth-GFSK	CH 0	2402	10.33	10.50	---	No
	CH 39	2441	10.60	11.00	---	No
	CH 78	2480	10.67	11.00	1.08	Yes
Bluetooth-8-DPSK	CH 0	2402	7.76	8.00	---	No
	CH 39	2441	8.07	8.50	---	No
	CH 78	2480	7.59	8.00	---	No
BLE	CH 37	2402	8.32	8.50	---	No
	CH 17	2440	8.39	8.50	---	No
	CH 39	2480	8.07	8.50	---	No

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6.6. SAR Test Result

Note:

1. Per KDB 447498 D01, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
   Scale Factor = tune-up limit power (mW) / EUT Conducted power (mW), where tune-up limit is the maximum rated power among all production units.
   Scale SAR(W/kg)= Measured SAR(W/kg)* Scaling Factor
2. Per KDB 447498 D01, for each exposure position, if the highest output channel reported SAR ≤0.8W/kg, other channels SAR testing is not necessary.
3. Pursuant section 2.8.1(2) KDB 865664 D01, when the original highest measured SAR is ≥ 0.80 W/kg, repeat that measurement once.
4. Pursuant section 2.8.1(3) KDB 865664 D01, 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)

Test Date	2018/10/27	Temp./Hum.	23℃/52%
Test Voltage	AC 120V, 60Hz (with AC Adapter)		

Liquid Temperature : 22.1℃								Depth of Liquid:＞15cm		
Test Mode: 2.4GHz										
Plot No.	Test Position: Body	Antenna Position	Separation Distance (cm)	Frequency	Conducted power (dBm)	Maximum Tune-up (dBm)	SAR 1g (W/kg)	Scale Factor	Scale SAR	Limit (W/kg)
802.11b										
Antenna: Main										
21	Rear	Fixed	0	2437	21.06	21.5	0.214	1.11	0.237	1.60
Antenna: AUX										
22	Rear	Fixed	0	2437	20.61	21.5	0.178	1.11	0.198	1.60

Liquid Temperature : 22.1℃								Depth of Liquid:＞15cm		
Test Mode: 2.4GHz										
Plot No.	Test Position: Body	Antenna Position	Separation Distance (cm)	Frequency	Conducted power (dBm)	Maximum Tune-up (dBm)	SAR 1g (W/kg)	Scale Factor	Scale SAR	Limit (W/kg)
802.11n-HT20										
Antenna: Main										
25	Rear	Fixed	0	2437	17.24	21.0	0.172	1.09	**0.187**	1.60
Antenna: AUX										
26	Rear	Fixed	0	2437	17.62	21.0	0.185	1.09	0.202	1.60

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Test Date	2018/10/28 ~ 30	Temp./Hum.	23~24℃/52~54%
Test Voltage	AC 120V, 60Hz (with AC Adapter)		

Liquid Temperature : 22.1~22.2℃ Depth of Liquid:＞15cm

Test Mode: 5GHz

Plot No.	Test Position: Body	Antenna Position	Separation Distance (cm)	Frequency	Conducted power (dBm)	Maximum Tune-up (dBm)	SAR 1g (W/kg)	Scale Factor	Scale SAR	Limit (W/kg)
802.11a (UNII Band II-2A)										
Antenna: Main										
7	Rear	Fixed	0	5260	20.61	21.0	0.147	1.09	0.161	1.60
Antenna: AUX										
8	Rear	Fixed	0	5260	20.64	21.0	0.313	1.09	0.340	1.60
802.11a (UNII Band II-2C)										
Antenna: Main										
9	Rear	Fixed	0	5580	21.01	21.5	0.448	1.06	0.475	1.60
Antenna: AUX										
10	Rear	Fixed	0	5580	21.26	21.5	0.309	1.06	0.327	1.60
802.11a (UNII Band III)										
Antenna: Main										
11	Rear	Fixed	0	5745	21.45	21.5	0.500	1.01	**0.505**	1.60
Antenna: AUX										
12	Rear	Fixed	0	5745	21.37	21.5	0.308	1.01	0.311	1.60

Liquid Temperature : 22.1℃ Depth of Liquid:＞15cm

Test Mode: 5GHz

Plot No.	Test Position: Body	Antenna Position	Separation Distance (cm)	Frequency	Conducted power (dBm)	Maximum Tune-up (dBm)	SAR 1g (W/kg)	Scale Factor	Scale SAR	Limit (W/kg)
802.11n-HT20 (UNII Band II-2C)										
Antenna: Main										
3	Rear	Fixed	0	5580	18.65	21.5	0.373	1.06	0.395	1.60
Antenna: AUX										
4	Rear	Fixed	0	5580	17.35	21.5	0.036	1.06	0.038	1.60

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Test Date	2018/10/28 ~ 30	Temp./Hum.	23~24℃/52~54%
Test Voltage	AC 120V, 60Hz (with AC Adapter)		

Liquid Temperature : 22.1~22.2℃								Depth of Liquid:＞15cm		
Test Mode: 5GHz										
Plot No.	Test Position: Body	Antenna Position	Separation Distance (cm)	Frequency	Conducted power (dBm)	Maximum Tune-up (dBm)	SAR 1g (W/kg)	Scale Factor	Scale SAR	Limit (W/kg)
802.11n-HT40 (UNII Band II-2A)										
Antenna: Main										
5	Rear	Fixed	0	5270	18.27	22.0	0.064	1.04	0.067	1.60
Antenna: AUX										
6	Rear	Fixed	0	5270	18.61	22.0	0.021	1.04	0.022	1.60
802.11n-HT40 (UNII Band III)										
Antenna: Main										
1	Rear	Fixed	0	5795	19.74	23.5	0.434	1.08	0.469	1.60
Antenna: AUX										
2	Rear	Fixed	0	5795	19.85	23.5	0.372	1.08	**0.402**	1.60

Test Date	2018/10/27	Temp./Hum.	23℃/52%
Test Voltage	AC 120V, 60Hz (with AC Adapter)		

Liquid Temperature : 22.1℃								Depth of Liquid:＞15cm		
Test Mode: BT-GFSK										
Plot No.	Test Position: Body	Antenna Position	Separation Distance (cm)	Frequency	Conducted power (dBm)	Maximum Tune-up (dBm)	SAR 1g (W/kg)	Scale Factor	Scale SAR	Limit (W/kg)
Antenna: Main										
25	Rear	Fixed	0	2480	10.67	11	0.084	1.08	0.091	1.60

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APPENDIX A

GRAPH RESULT

(Model:17Z990)

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Date: 10/27/2018

Test Laboratory: Audix_SAR Lab

P21 802.11b CH6 2437MHz Main

DUT: 17Z990

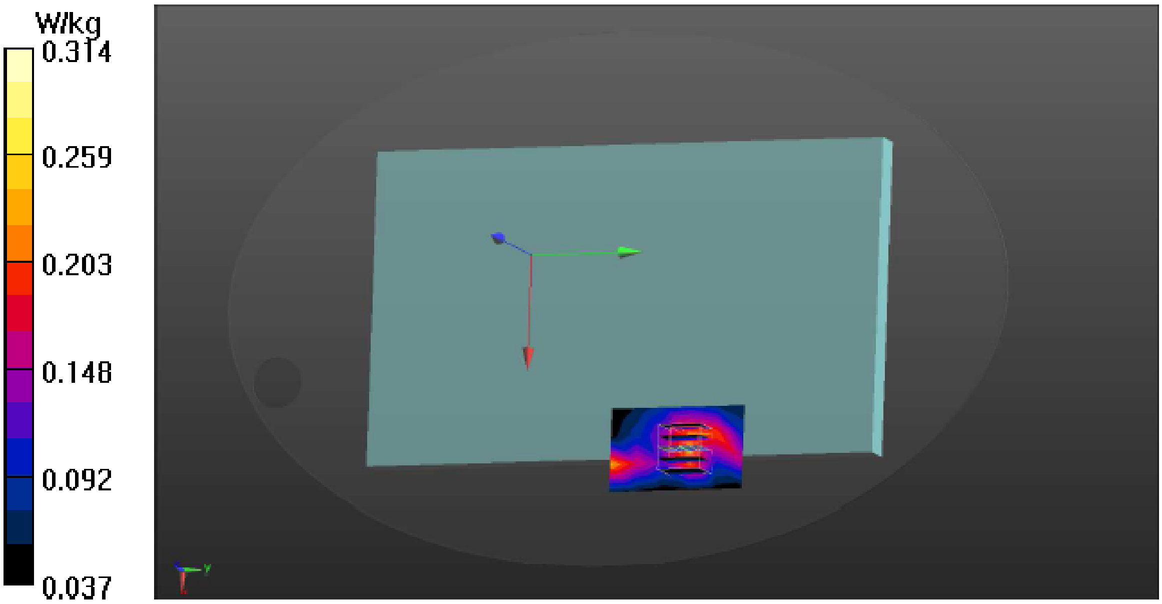
Communication System: UID 0, WIFI 2.4G 802.11B (0); Frequency: 2437 MHz;Duty Cycle:1:1
Medium parameters used: f = 2437 MHz; σ = 1.977 S/m; ε_r = 51.669; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3855; ConvF(7.67, 7.67, 7.67); Calibrated: 9/27/2018;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1337; Calibrated: 9/19/2018
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1170
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Area Scan (4x6x1): Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (measured) = 0.232 W/kg

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 3.466 V/m; Power Drift = -0.28 dB
Peak SAR (extrapolated) = 0.434 W/kg
SAR(1 g) = 0.214 W/kg; SAR(10 g) = 0.125 W/kg
Maximum value of SAR (measured) = 0.314 W/kg



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Date: 10/27/2018

Test Laboratory: Audix_SAR Lab

P22 802.11b CH6 2437MHz Aux

DUT: 17Z990

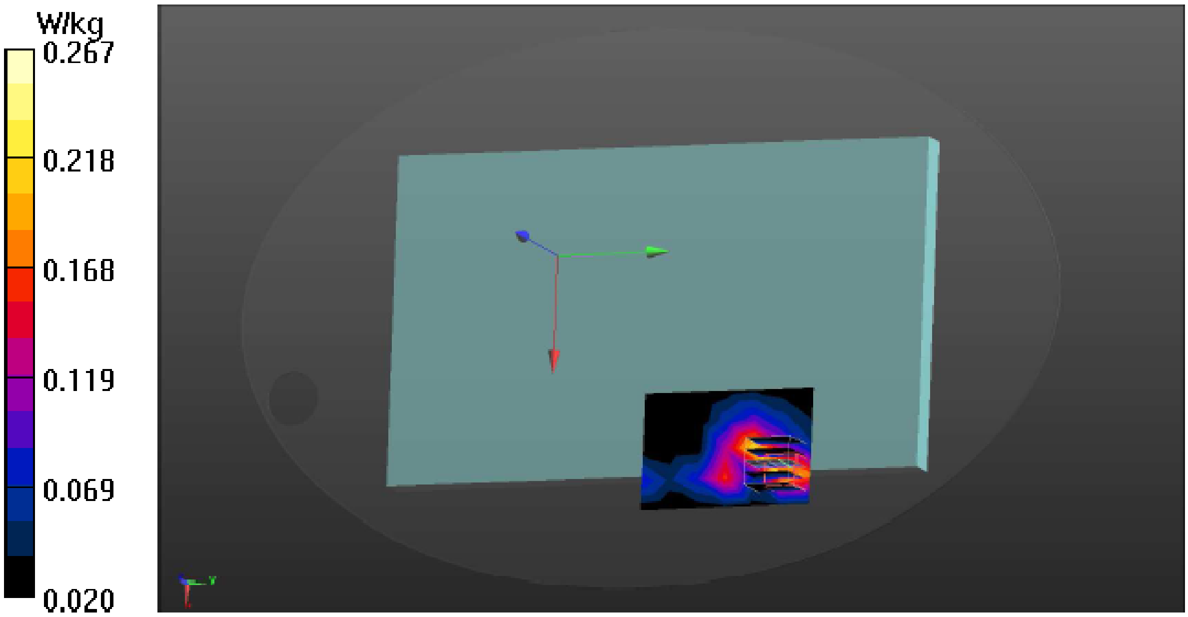
Communication System: UID 0, WIFI 2.4G 802.11B (0); Frequency: 2437 MHz;Duty Cycle:1:1
Medium parameters used: f = 2437 MHz; σ = 1.977 S/m; ε_r = 51.669; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3855; ConvF(7.67, 7.67, 7.67); Calibrated: 9/27/2018;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1337; Calibrated: 9/19/2018
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1170
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Area Scan (5x7x1): Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (measured) = 0.217 W/kg

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 2.188 V/m; Power Drift = 1.37 dB
Peak SAR (extrapolated) = 0.372 W/kg
SAR(1 g) = 0.178 W/kg; SAR(10 g) = 0.088 W/kg
Maximum value of SAR (measured) = 0.267 W/kg



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Date: 10/27/2018

Test Laboratory: Audix_SAR Lab

P25 802.11n-HT20 CH6 2437MHz Main

DUT: 17Z990

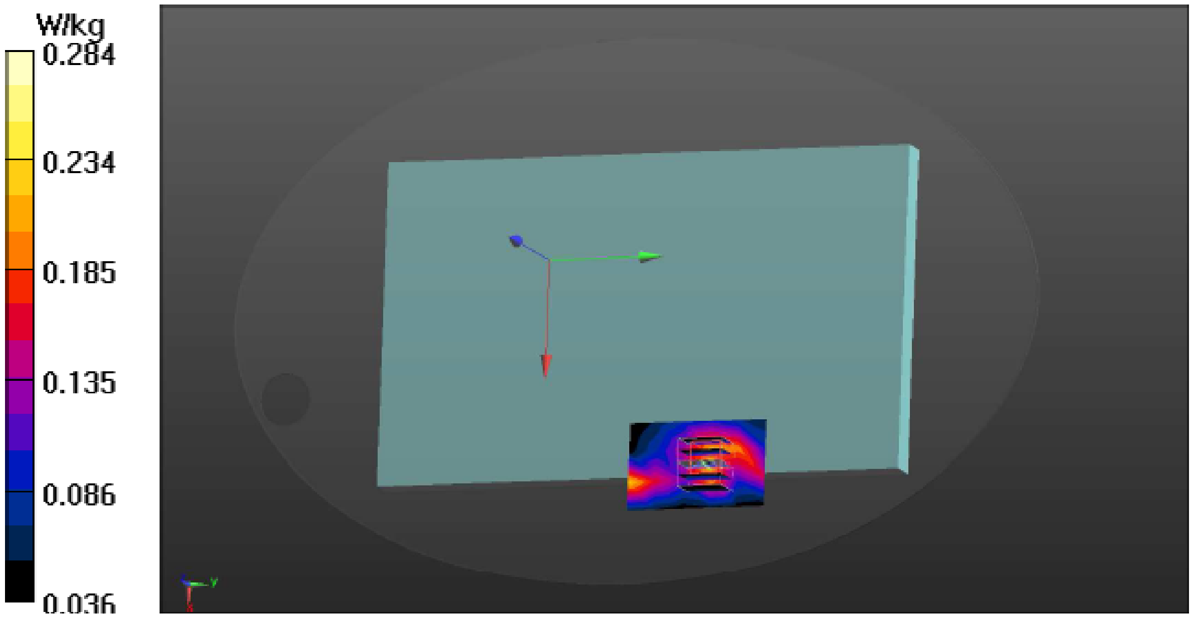
Communication System: UID 0, WIFI 2.4G 802.11HT_20 (0); Frequency: 2437 MHz;Duty Cycle:1:1.046
Medium parameters used: f = 2437 MHz; σ = 1.977 S/m; ε_r = 51.669; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3855; ConvF(7.67, 7.67, 7.67); Calibrated: 9/27/2018;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1337; Calibrated: 9/19/2018
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1170
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Area Scan (4x6x1): Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (measured) = 0.226 W/kg

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 3.052 V/m; Power Drift = -0.88 dB
Peak SAR (extrapolated) = 0.364 W/kg
SAR(1 g) = 0.172 W/kg; SAR(10 g) = 0.104 W/kg
Maximum value of SAR (measured) = 0.284 W/kg



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Test Laboratory: Audix_SAR Lab

P26 802.11n-HT20 CH6 2437MHz Aux

DUT: 17Z990

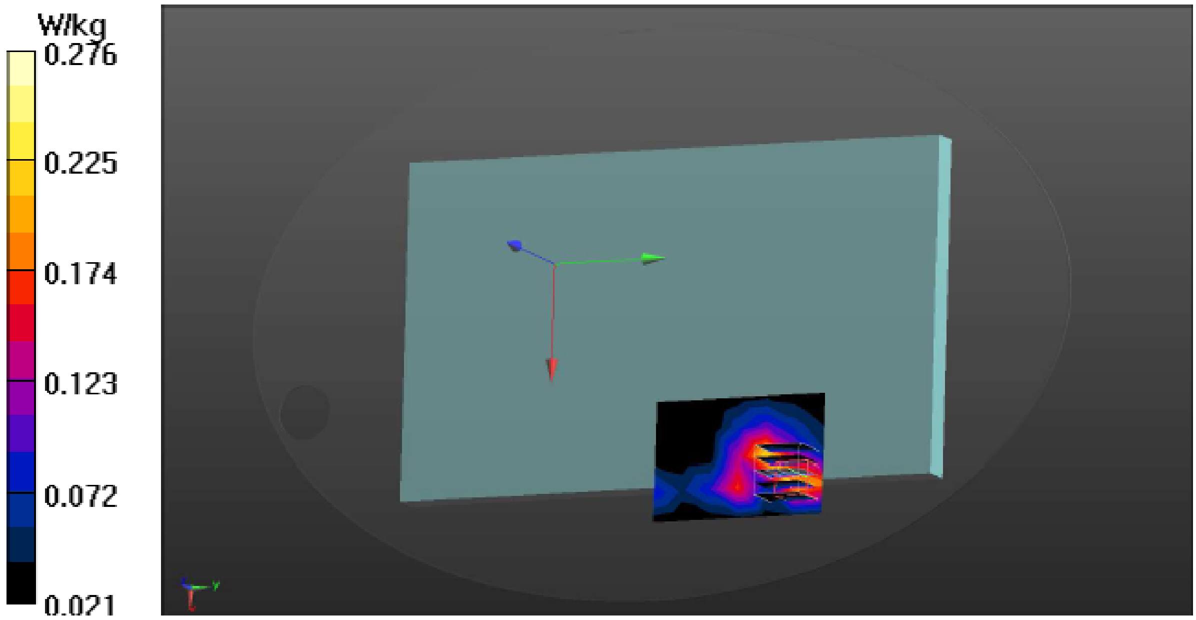
Communication System: UID 0, WIFI 2.4G 802.11HT_20 (0); Frequency: 2437 MHz;Duty Cycle:1:1.046
Medium parameters used: f = 2437 MHz; σ = 1.977 S/m; ε_r = 51.669; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3855; ConvF(7.67, 7.67, 7.67); Calibrated: 9/27/2018;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1337; Calibrated: 9/19/2018
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1170
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Area Scan (5x7x1): Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (measured) = 0.225 W/kg

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 2.200 V/m; Power Drift = 1.37 dB
Peak SAR (extrapolated) = 0.385 W/kg
SAR(1 g) = 0.185 W/kg; SAR(10 g) = 0.092 W/kg
Maximum value of SAR (measured) = 0.276 W/kg



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Date: 10/28/2018

Test Laboratory: Audix_SAR Lab

P7 802.11a CH52 5260MHz Main

DUT: 17Z990

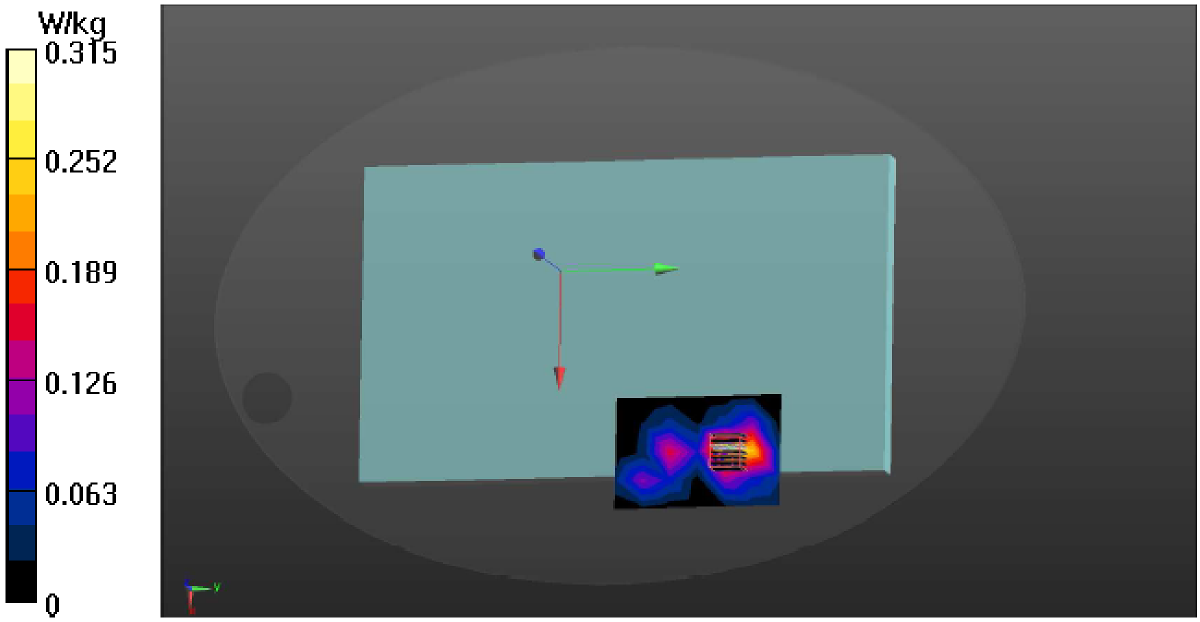
Communication System: UID 0, WIFI 5G 802.11a (0); Frequency: 5260 MHz;Duty Cycle:1:1
Medium parameters used: f = 5260 MHz; σ = 5.419 S/m; ε_r = 47.514; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3855; ConvF(4.37, 4.37, 4.37); Calibrated: 9/27/2018;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1337; Calibrated: 9/19/2018
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1170
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Area Scan (9x13x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.276 W/kg

Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 0 V/m; Power Drift = 0.53 dB
Peak SAR (extrapolated) = 0.506 W/kg
SAR(1 g) = 0.147 W/kg; SAR(10 g) = 0.057 W/kg
Maximum value of SAR (measured) = 0.315 W/kg



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Date: 10/28/2018

Test Laboratory: Audix_SAR Lab

P8 802.11a CH52 5260MHz Aux

DUT: 17Z990

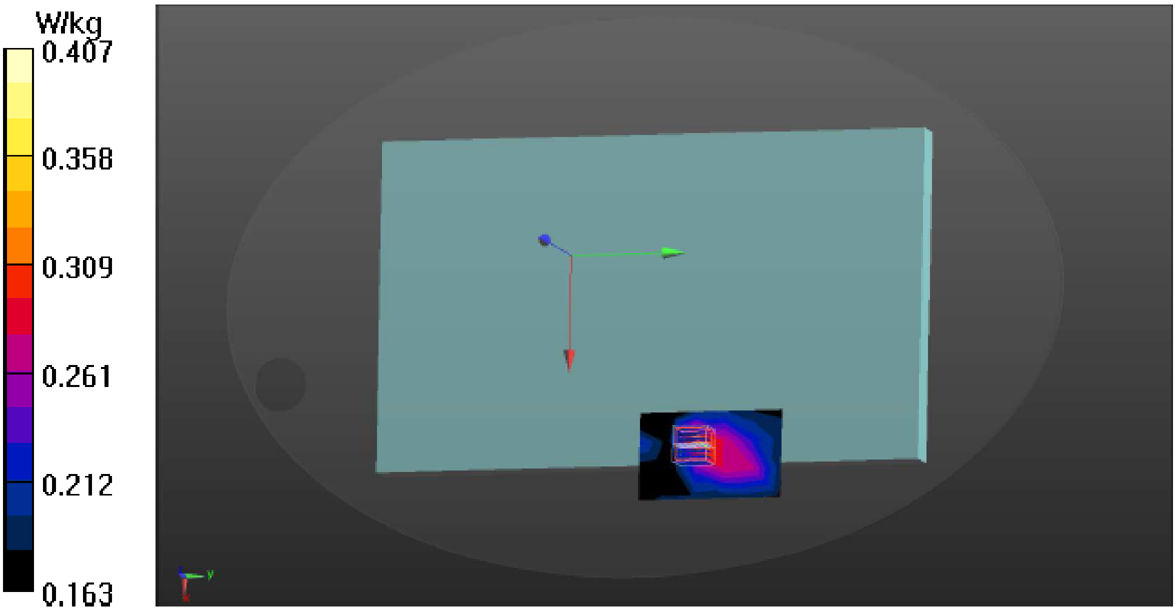
Communication System: UID 0, WIFI 5G 802.11a (0); Frequency: 5260 MHz;Duty Cycle:1:1
Medium parameters used: f = 5260 MHz; σ = 5.419 S/m; ε_r = 47.514; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3855; ConvF(4.37, 4.37, 4.37); Calibrated: 9/27/2018;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1337; Calibrated: 9/19/2018
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1170
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Area Scan (7x11x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.338 W/kg

Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 3.673 V/m; Power Drift = 1.86 dB
Peak SAR (extrapolated) = 0.662 W/kg
SAR(1 g) = 0.313 W/kg; SAR(10 g) = 0.240 W/kg
Maximum value of SAR (measured) = 0.407 W/kg



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Date: 10/29/2018

Test Laboratory: Audix_SAR Lab

P9 802.11a CH116 5580MHz Main

DUT: 17Z990

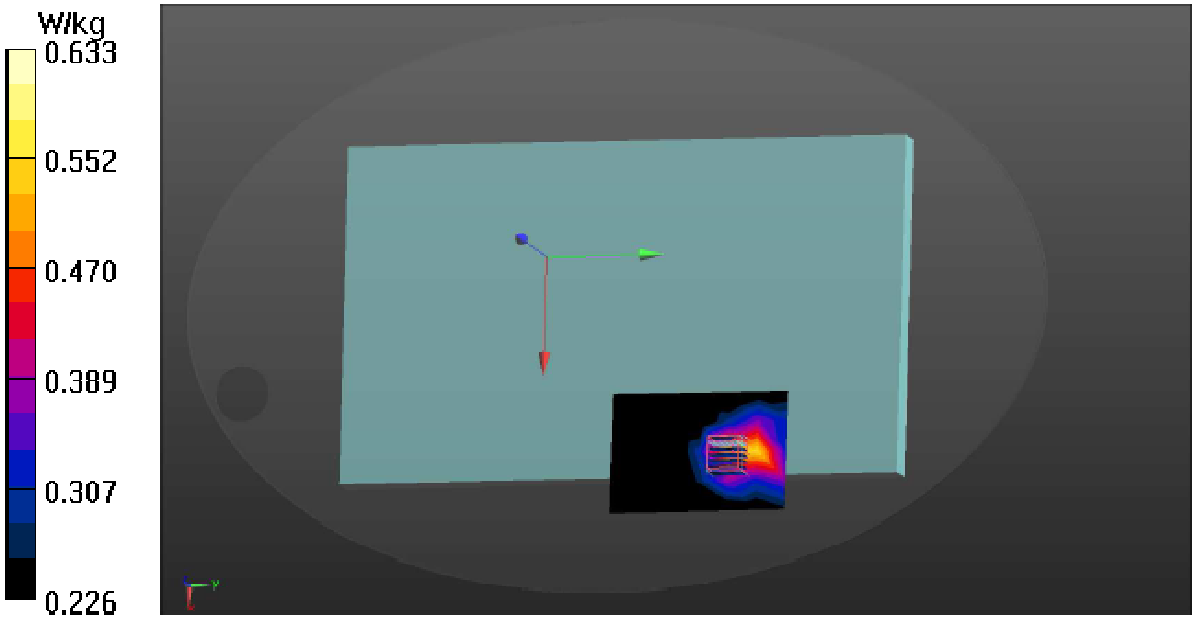
Communication System: UID 0, WIFI 5G 802.11a (0); Frequency: 5580 MHz;Duty Cycle:1:1
Medium parameters used: f = 5580 MHz; σ = 5.86 S/m; ε_r = 46.89; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3855; ConvF(4.07, 4.07, 4.07); Calibrated: 9/27/2018;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1337; Calibrated: 9/19/2018
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1170
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Area Scan (9x13x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.556 W/kg

Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 4.917 V/m; Power Drift = 1.83 dB
Peak SAR (extrapolated) = 1.10 W/kg
SAR(1 g) = 0.448 W/kg; SAR(10 g) = 0.340 W/kg
Maximum value of SAR (measured) = 0.633 W/kg



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0.

Date: 10/29/2018

Test Laboratory: Audix_SAR Lab

P10 802.11a CH116 5580MHz Aux

DUT: 17Z990

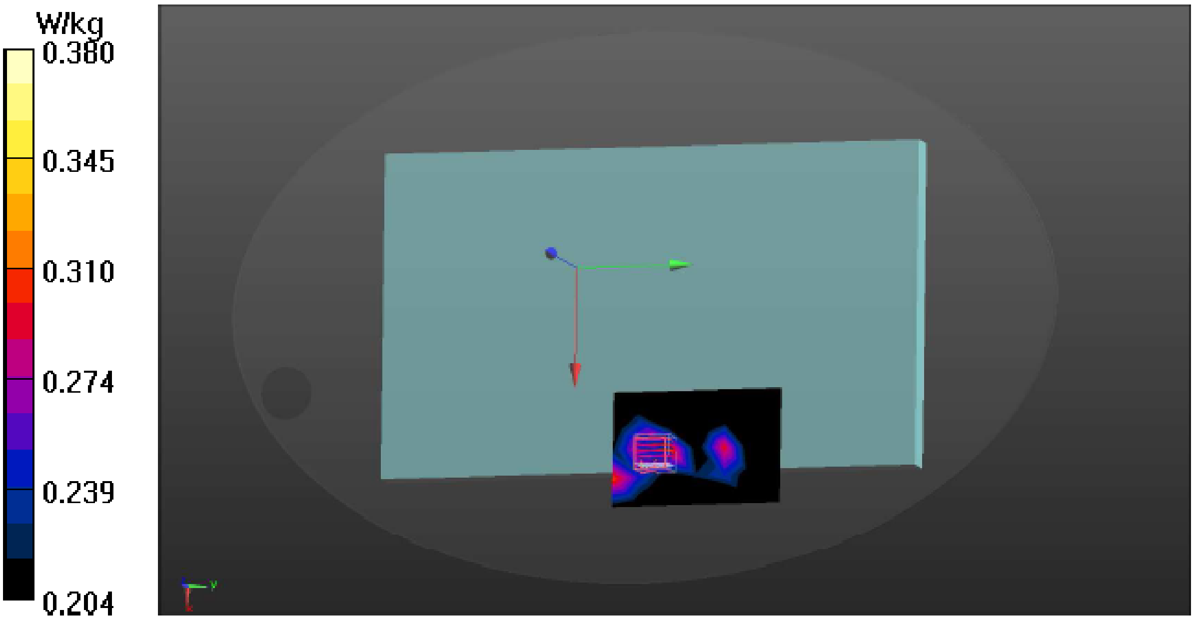
Communication System: UID 0, WIFI 5G 802.11a (0); Frequency: 5580 MHz;Duty Cycle:1:1
Medium parameters used: f = 5580 MHz; σ = 5.86 S/m; ε_r = 46.89; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3855; ConvF(4.07, 4.07, 4.07); Calibrated: 9/27/2018;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1337; Calibrated: 9/19/2018
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1170
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Area Scan (9x13x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.312 W/kg

Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 5.229 V/m; Power Drift = 0.95 dB
Peak SAR (extrapolated) = 0.742 W/kg
SAR(1 g) = 0.309 W/kg; SAR(10 g) = 0.264 W/kg
Maximum value of SAR (measured) = 0.380 W/kg



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Tel: +886 2 26099301
Fax: +886 2 26099303

Date: 10/30/2018

Test Laboratory: Audix_SAR Lab

P11 802.11a CH165 5825MHz Main

DUT: 17Z990

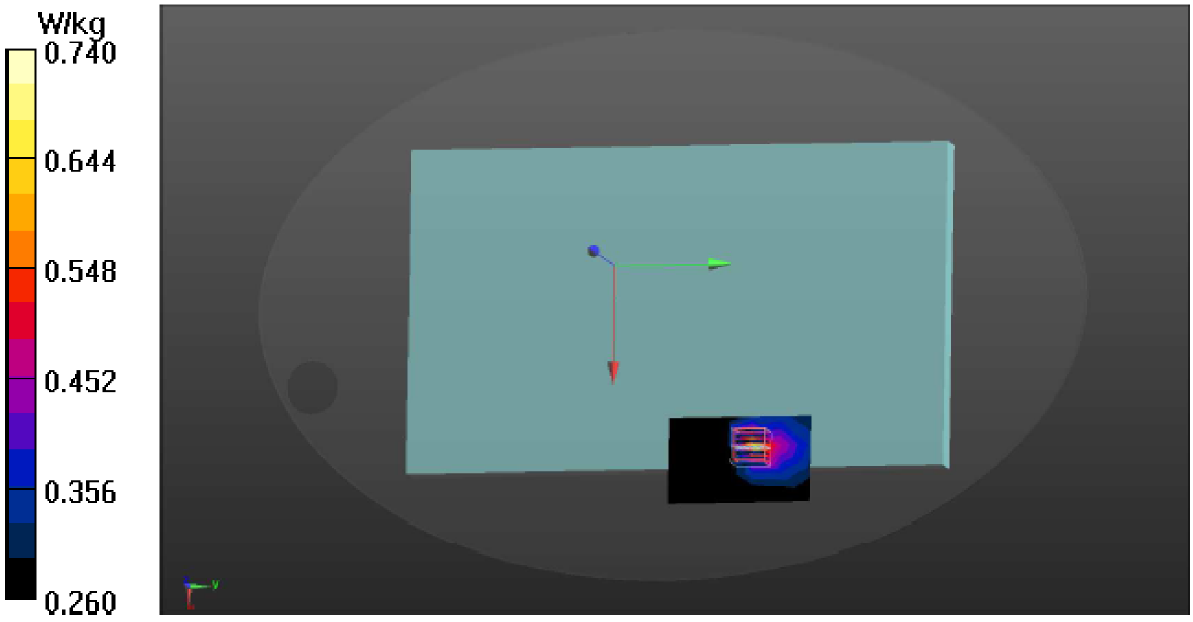
Communication System: UID 0, WIFI 5G 802.11a (0); Frequency: 5825 MHz;Duty Cycle:1:1
Medium parameters used: f = 5825 MHz; σ = 6.217 S/m; ε_r = 46.371; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3855; ConvF(4.3, 4.3, 4.3); Calibrated: 9/27/2018;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1337; Calibrated: 9/19/2018
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1170
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Area Scan (7x11x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.637 W/kg

Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 4.275 V/m; Power Drift = 1.80 dB
Peak SAR (extrapolated) = 1.24 W/kg
SAR(1 g) = 0.522 W/kg; SAR(10 g) = 0.376 W/kg
Maximum value of SAR (measured) = 0.740 W/kg



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0.3R

Date: 10/30/2018

Test Laboratory: Audix_SAR Lab

P12 802.11a CH165 5825MHz Aux

DUT: 17Z990

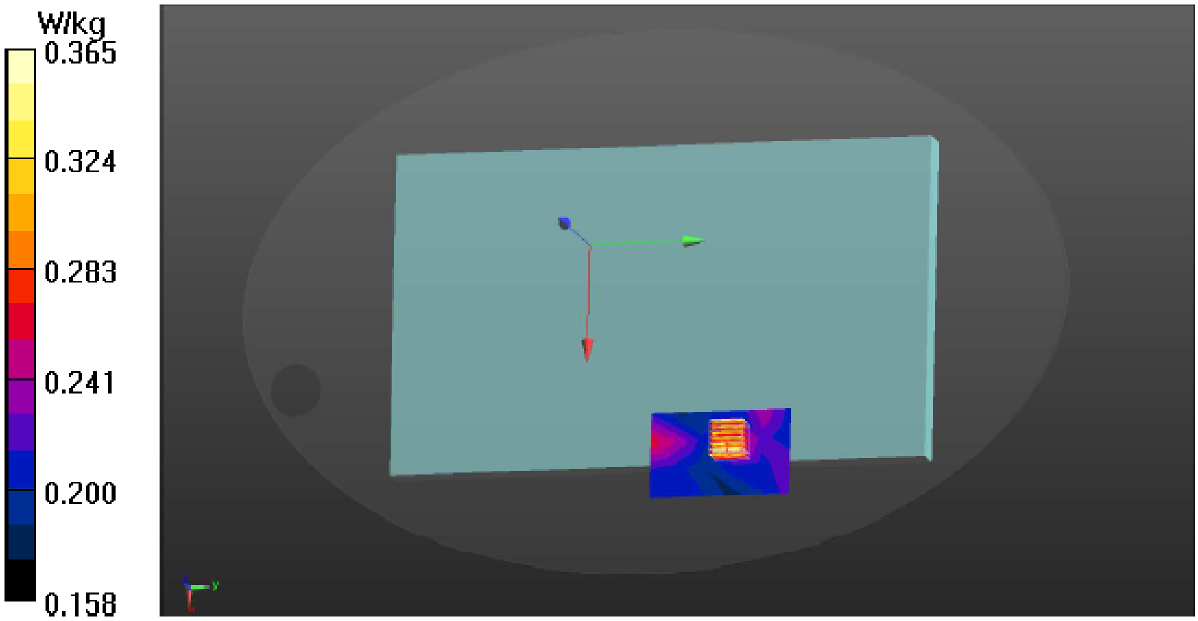
Communication System: UID 0, WIFI 5G 802.11a (0); Frequency: 5825 MHz;Duty Cycle:1:1
Medium parameters used: f = 5825 MHz; σ = 6.217 S/m; ε_r = 46.371; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3855; ConvF(4.3, 4.3, 4.3); Calibrated: 9/27/2018;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1337; Calibrated: 9/19/2018
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1170
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Area Scan (7x11x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.268 W/kg

Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 5.336 V/m; Power Drift = 1.00 dB
Peak SAR (extrapolated) = 0.365 W/kg
SAR(1 g) = 0.321 W/kg; SAR(10 g) = 0.284 W/kg
Maximum value of SAR (measured) = 0.365 W/kg



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Test Laboratory: Audix_SAR Lab

P3 802.11n-HT20 CH116 5580MHz Main

DUT: 17Z990

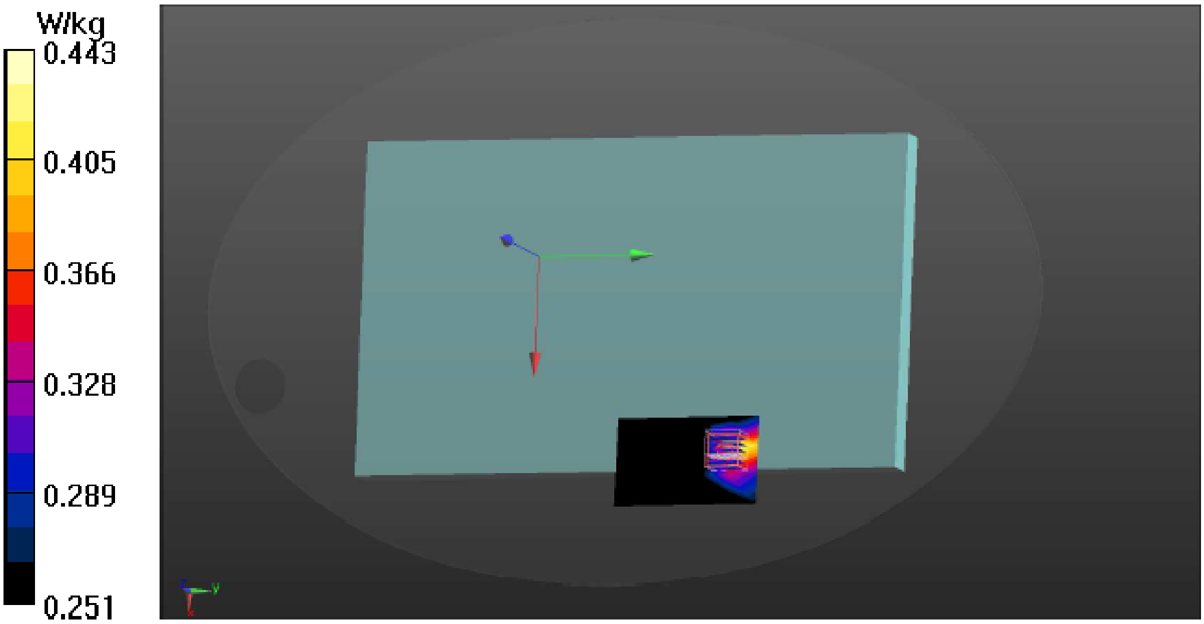
Communication System: UID 0, WIFI 5G 802.11HT_20 (0); Frequency: 5580 MHz;Duty Cycle:1:1.042
Medium parameters used: f = 5580 MHz; σ = 5.86 S/m; ε_r = 46.89; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3855; ConvF(4.07, 4.07, 4.07); Calibrated: 9/27/2018;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1337; Calibrated: 9/19/2018
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1170
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Area Scan (7x11x1): Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (measured) = 0.442 W/kg

Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 5.614 V/m; Power Drift = 1.36 dB
Peak SAR (extrapolated) = 0.844 W/kg
SAR(1 g) = 0.373 W/kg; SAR(10 g) = 0.324 W/kg
Maximum value of SAR (measured) = 0.443 W/kg



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Date: 10/29/2018

Test Laboratory: Audix_SAR Lab

P4 802.11n-HT20 CH116 5580MHz Aux

DUT: 17Z990

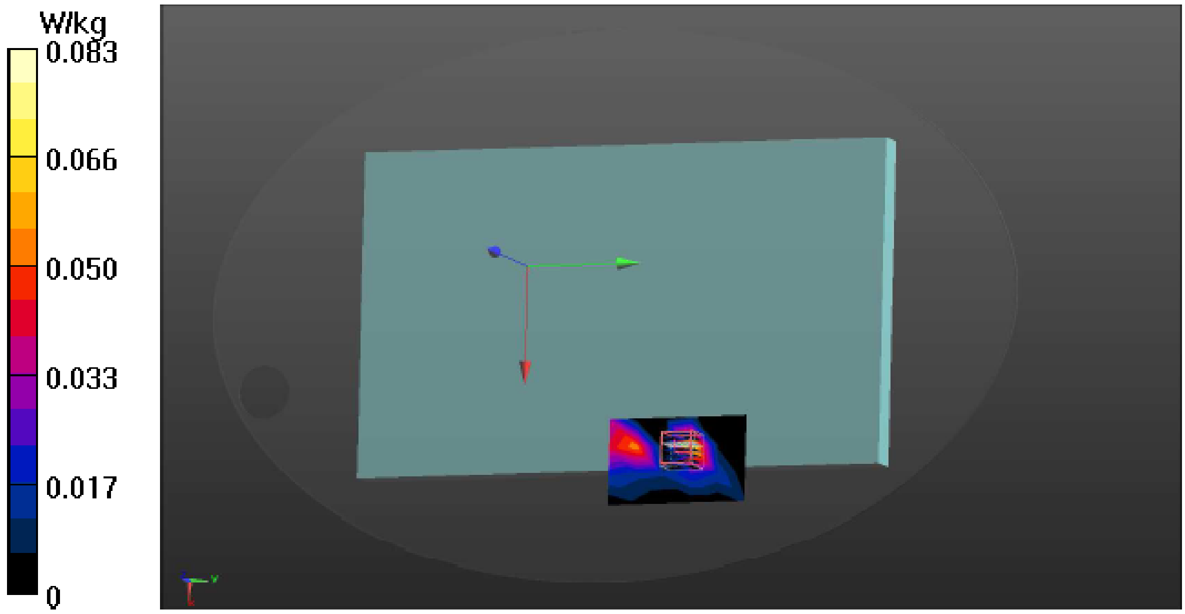
Communication System: UID 0, WIFI 5G 802.11HT_20 (0); Frequency: 5580 MHz;Duty Cycle:1:1.042
Medium parameters used: f = 5580 MHz; σ = 5.86 S/m; ε_r = 46.89; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3855; ConvF(4.07, 4.07, 4.07); Calibrated: 9/27/2018;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1337; Calibrated: 9/19/2018
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1170
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Area Scan (7x11x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.0711 W/kg

Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 0.352 V/m; Power Drift = 0.55 dB
Peak SAR (extrapolated) = 0.378 W/kg
SAR(1 g) = 0.036 W/kg; SAR(10 g) = 0.010 W/kg
Maximum value of SAR (measured) = 0.0825 W/kg



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Date: 10/28/2018

Test Laboratory: Audix_SAR Lab

P5 802.11n-HT40 CH54 5270MHz Main

DUT: 17Z990

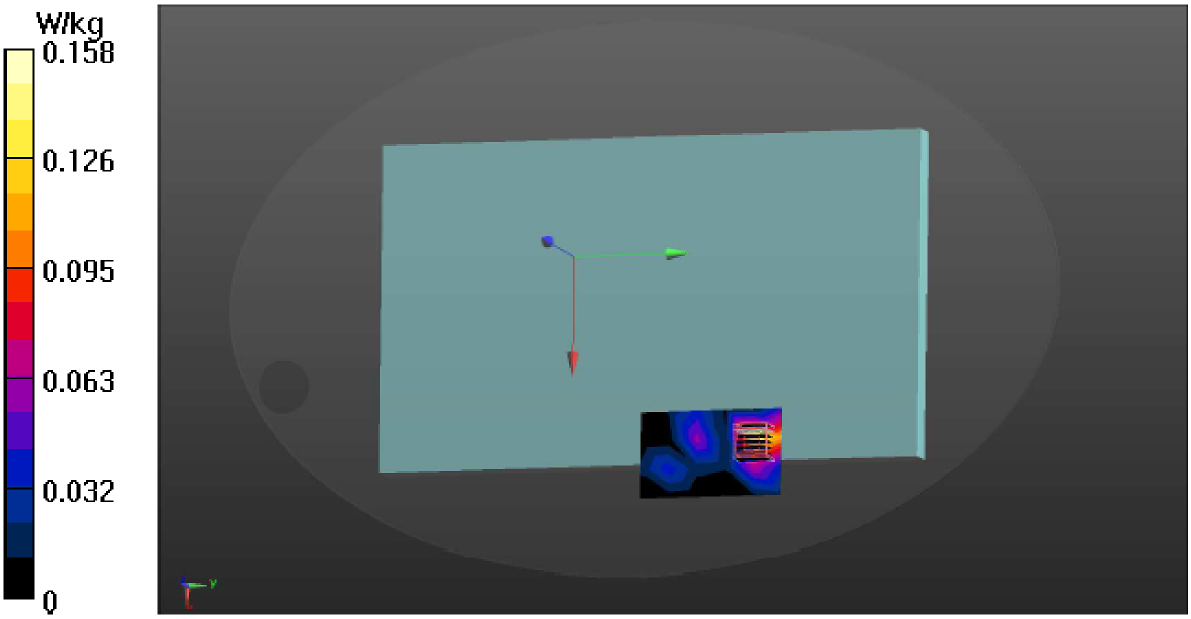
Communication System: UID 0, WIFI 5G 802.11HT_40 (0); Frequency: 5270 MHz;Duty Cycle:1:1.087
Medium parameters used: f = 5270 MHz; σ = 5.435 S/m; ε_r = 47.481; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3855; ConvF(4.37, 4.37, 4.37); Calibrated: 9/27/2018;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1337; Calibrated: 9/19/2018
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1170
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Area Scan (7x11x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.140 W/kg

Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 0.365 V/m; Power Drift = 1.00 dB
Peak SAR (extrapolated) = 0.225 W/kg
SAR(1 g) = 0.064 W/kg; SAR(10 g) = 0.026 W/kg
Maximum value of SAR (measured) = 0.158 W/kg



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Fax: +886 2 26099303

Date: 10/28/2018

Test Laboratory: Audix_SAR Lab

P6 802.11n-HT40 CH54 5270MHz Aux

DUT: 17Z990

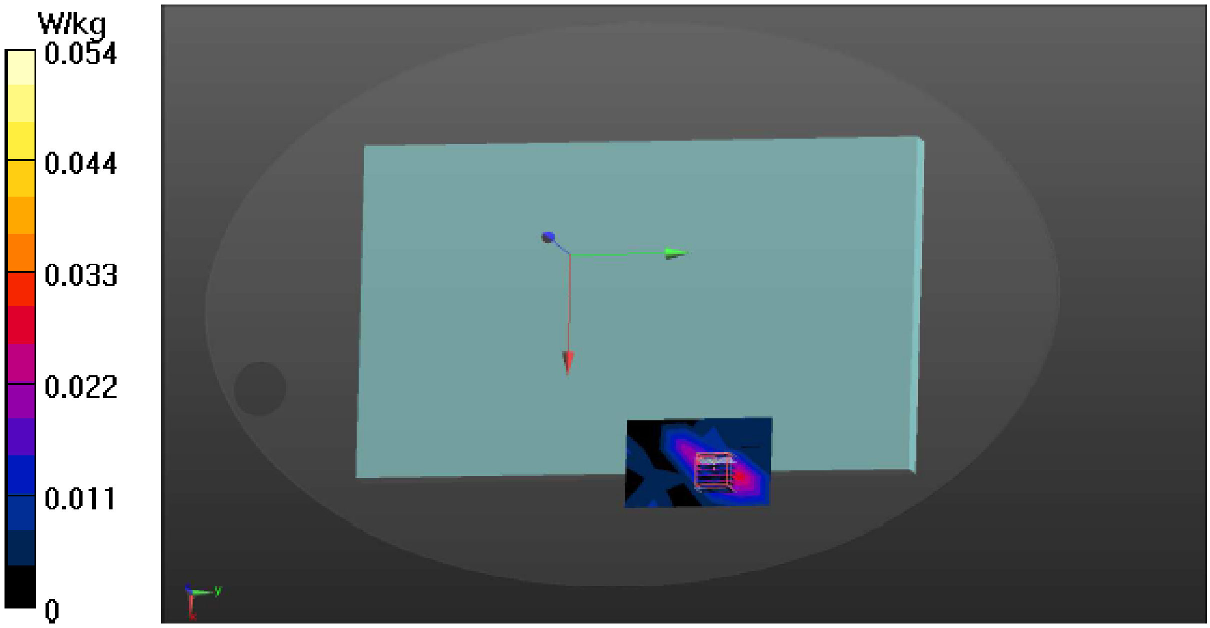
Communication System: UID 0, WIFI 5G 802.11HT_40 (0); Frequency: 5270 MHz;Duty Cycle:1:1.087
Medium parameters used: f = 5270 MHz; $\sigma = 5.435$ S/m; $\varepsilon_r = 47.481$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3855; ConvF(4.37, 4.37, 4.37); Calibrated: 9/27/2018;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1337; Calibrated: 9/19/2018
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1170
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Area Scan (7x11x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.0281 W/kg

Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 0.322 V/m; Power Drift = 0.95 dB
Peak SAR (extrapolated) = 0.0790 W/kg
SAR(1 g) = 0.021 W/kg; SAR(10 g) = 0.00644 W/kg
Maximum value of SAR (measured) = 0.0544 W/kg



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Date: 10/30/2018

Test Laboratory: Audix_SAR Lab

P1 802.11n-HT40 CH159 5795MHz Main

DUT: 17Z990

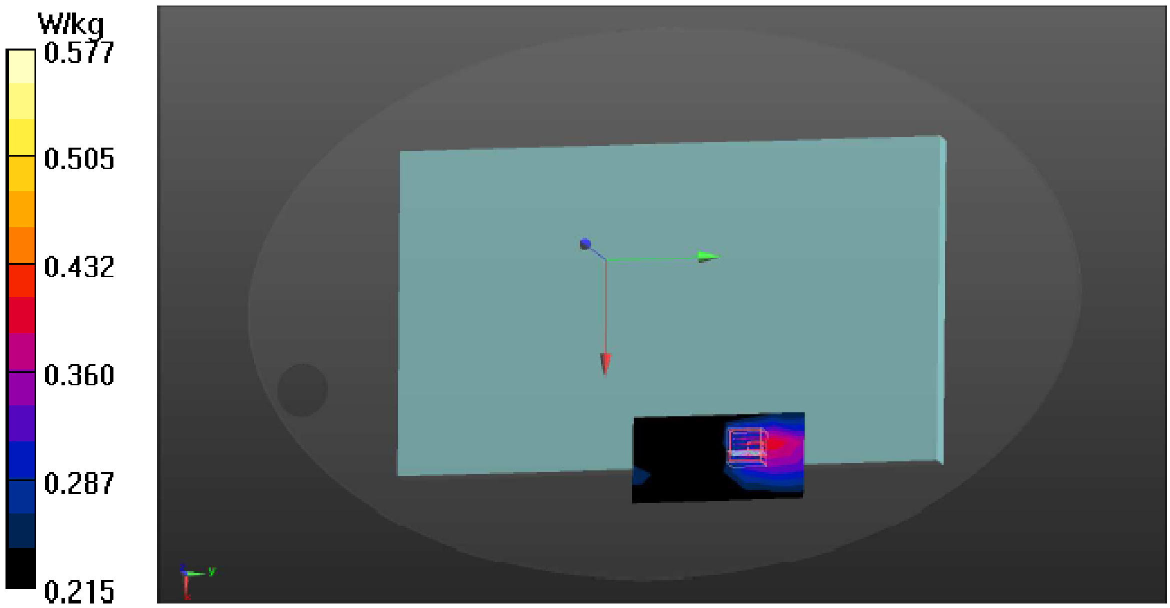
Communication System: UID 0, WIFI 5G 802.11HT_40 (0); Frequency: 5795 MHz;Duty Cycle:1:1.087
Medium parameters used: f = 5795 MHz; σ = 6.166 S/m; ε_r = 46.508; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3855; ConvF(4.3, 4.3, 4.3); Calibrated: 9/27/2018;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1337; Calibrated: 9/19/2018
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1170
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Area Scan (7x13x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.414 W/kg

Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 5.177 V/m; Power Drift = 1.74 dB
Peak SAR (extrapolated) = 0.975 W/kg
SAR(1 g) = 0.434 W/kg; SAR(10 g) = 0.327 W/kg
Maximum value of SAR (measured) = 0.577 W/kg



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Fax: +886 2 26099303

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Date: 10/30/2018

Test Laboratory: Audix_SAR Lab

P2 802.11n-HT40 CH159 5795MHz Aux

DUT: 17Z990

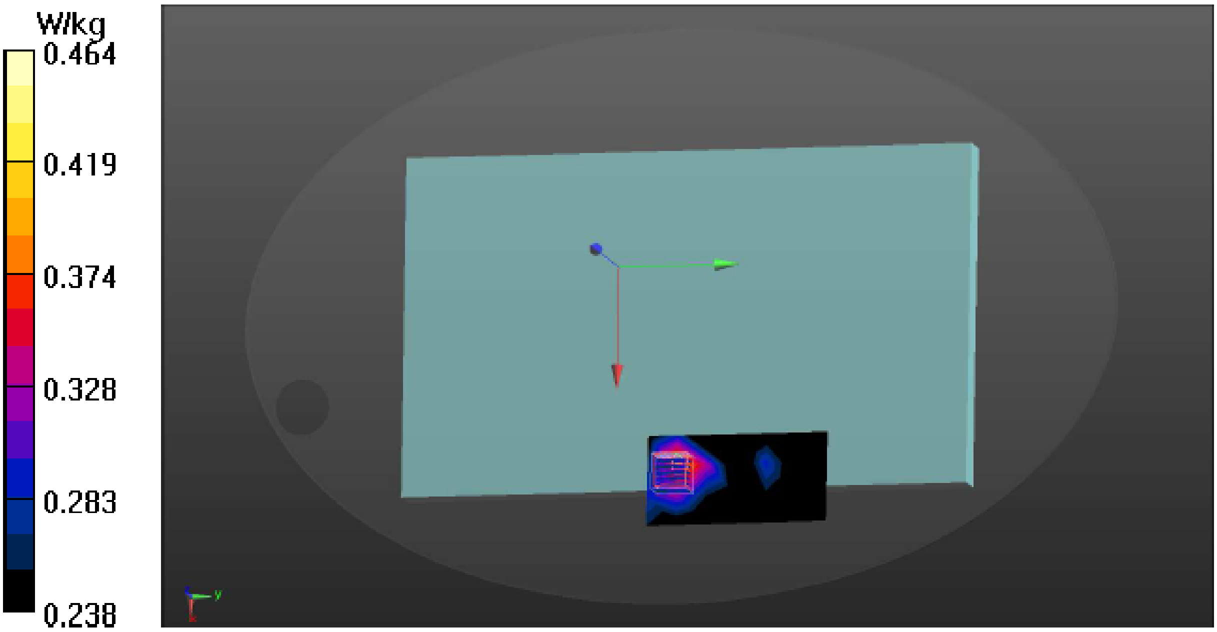
Communication System: UID 0, WIFI 5G 802.11HT_40 (0); Frequency: 5795 MHz;Duty Cycle:1:1.087
Medium parameters used: f = 5795 MHz; σ = 6.166 S/m; ε_r = 46.508; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3855; ConvF(4.3, 4.3, 4.3); Calibrated: 9/27/2018;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1337; Calibrated: 9/19/2018
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1170
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Area Scan (7x13x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.416 W/kg

Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 5.386 V/m; Power Drift = 1.42 dB
Peak SAR (extrapolated) = 0.929 W/kg
SAR(1 g) = 0.372 W/kg; SAR(10 g) = 0.318 W/kg
Maximum value of SAR (measured) = 0.464 W/kg



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Fax: +886 2 26099303

Date: 10/27/2018

Test Laboratory: Audix_SAR Lab

P23 GFSK CH78 2480MHz Main

DUT: 17Z990

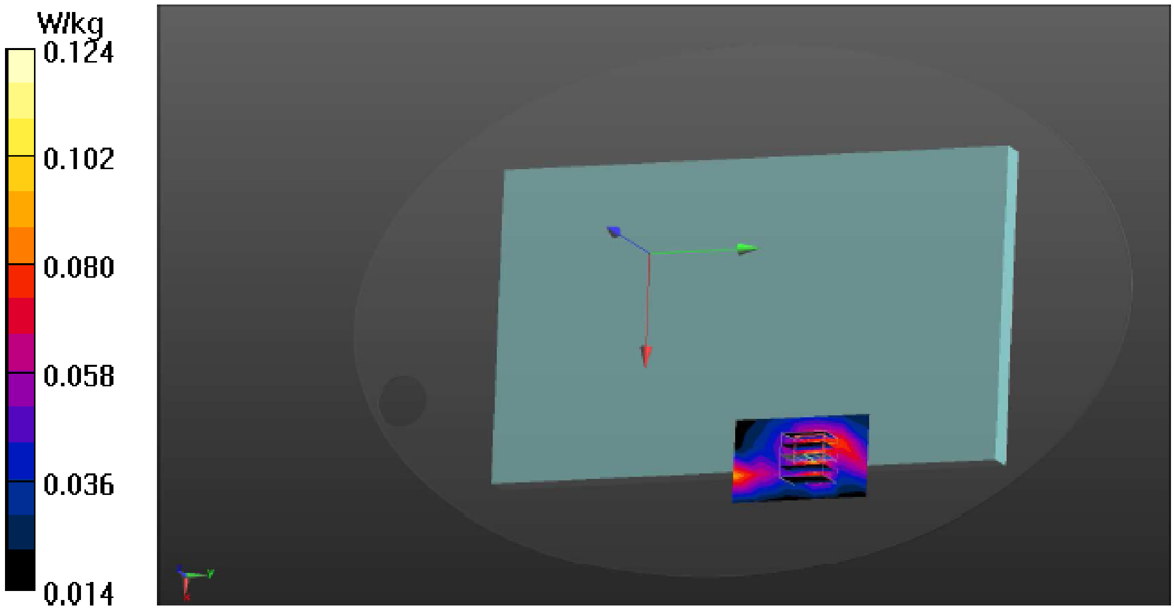
Communication System: UID 0, BT (0); Frequency: 2480 MHz;Duty Cycle:1:1.3
Medium parameters used: f = 2480 MHz; σ = 2.034 S/m; ε_r = 51.509; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3855; ConvF(7.67, 7.67, 7.67); Calibrated: 9/27/2018;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1337; Calibrated: 9/19/2018
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1170
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Area Scan (4x6x1): Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (measured) = 0.0914 W/kg

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 3.124 V/m; Power Drift = -0.28 dB
Peak SAR (extrapolated) = 0.172 W/kg
SAR(1 g) = 0.084 W/kg; SAR(10 g) = 0.049 W/kg
Maximum value of SAR (measured) = 0.124 W/kg



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New Taipei City244,Taiwan

Tel: +886 2 26099301
Fax: +886 2 26099303

APPENDIX B

TEST PHOTOGRAPHS

(Model:17Z990)

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New Taipei City244,Taiwan

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Fax: +886 2 26099303

APPENDIX C

Test Equipment Calibration Data

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