

SAR TEST REPORT



The following samples were submitted and identified on behalf of the client as:

Equipment Under Test Desktop PC or Workstation
Brand Name HP
Model No. TPC-Q036-BP
Company Name Realtek Semiconductor Corp.
Company Address No. 2, Innovation Road II, Hsinchu Science Park, Hsinchu 300, Taiwan
Standards IEEE/ANSI C95.1-1992, IEEE 1528-2013, KDB248227D01v02r02, KDB865664D01v01r04, KDB865664D02v01r02, KDB447498D01v06,
FCC ID TX2-RTL8822BE
Date of Receipt Mar. 14, 2019
Date of Test(s) Mar. 20, 2019 ~ Mar. 24, 2019
Date of Issue Apr. 02, 2019


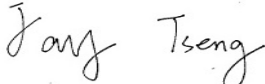
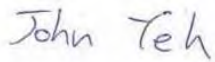
In the configuration tested, the EUT complied with the standards specified above.

Remarks:

This report details the results of the testing carried out on one sample, the results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

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Signed on behalf of SGS

Clerk / Annie Chang	Engineer / Jay Tseng	Supervisor / John Yeh
		

Date: Apr. 02, 2019

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Revision History

Report Number	Revision	Description	Issue Date
ES/2019/30008	Rev.00	Initial creation of document	Apr. 02, 2019

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1. General Information

1.1 Testing Laboratory

SGS Taiwan Ltd. Electronics & Communication Laboratory	
1F, No. 8, Alley 15, Lane 120, Sec. 1, NeiHu Road, Neihu District, Taipei City, 11493, Taiwan.	
Tel	+886-2-2299-3279
Fax	+886-2-2298-0488
Internet	http://www.tw.sgs.com/

1.2 Details of Applicant

Company Name	Realtek Semiconductor Corp.
Company Address	No. 2, Innovation Road II, Hsinchu Science Park, Hsinchu 300, Taiwan

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1.3 Description of EUT

Equipment Under Test	Desktop PC or Workstation	
Brand Name	HP	
Model No	TPC-Q036-BP	
Integrated module	Brand: REALTEK Model: RTL8822BE	
FCC ID	TX2-RTL8822BE	
Antenna Designation (Maximum Gain)	Main(TX2) _2.45GHz: -1.55 dBi, 5GHz: 0.45 dBi Aux(TX1) _2.45GHz: 1.14 dBi, 5GHz: 0.39 dBi	
Mode of Operation	<input checked="" type="checkbox"/> WLAN802.11 a/b/g/n(20M/40M)/ac(20M/40M/80M) <input checked="" type="checkbox"/> Bluetooth	
Duty Cycle	WLAN802.11 a/b/g/n(20M/40M)/ ac(20M/40M/80M)	1
	Bluetooth	1
TX Frequency Range (MHz)	WLAN802.11 b/g/n(20M)	2412 — 2472
	WLAN802.11 n(40M)	2422 — 2462
	WLAN802.11 a/n(20M)/ac(20M) 5.2G	5180 — 5240
	WLAN802.11 n(40M)/ac(40M) 5.2G	5190 — 5230
	WLAN802.11 ac(80M) 5.2G	5210
	WLAN802.11 a/n(20M)/ac(20M) 5.3G	5260 — 5320
	WLAN802.11 n(40M)/ac(40M) 5.3G	5270 — 5310
	WLAN802.11 ac(80M) 5.3G	5290
	WLAN802.11 a/n/ac(20M) 5.6G	5500 — 5720
	WLAN802.11 n/ac(40M) 5.6G	5510 — 5710
WLAN802.11 ac(80M) 5.6G	5530 — 5690	

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TX Frequency Range (MHz)	WLAN802.11 a/n(20M)/ac(20M) 5.8G	5745	—	5825
	WLAN802.11 n(40M)/ac(40M) 5.8G	5710	—	5795
	WLAN802.11 ac(80M) 5.8G	5775		
	Bluetooth	2402	—	2480
Channel Number (ARFCN)	WLAN802.11 b/g/n(20M)	1	—	13
	WLAN802.11 n(40M)	3	—	11
	WLAN802.11 a/n(20M)/ac(20M) 5.2G	36	—	48
	WLAN802.11 n(40M)/ac(40M) 5.2G	38	—	46
	WLAN802.11 ac(80M) 5.2G	42		
	WLAN802.11 a/n(20M)/ac(20M) 5.3G	52	—	64
	WLAN802.11 n(40M)/ac(40M) 5.3G	54	—	62
	WLAN802.11 ac(80M) 5.3G	58		
	WLAN802.11 a/n/ac(20M) 5.6G	100	—	144
	WLAN802.11 n/ac(40M) 5.6G	102	—	142
	WLAN802.11 ac(80M) 5.6G	106	—	138
	WLAN802.11 a/n(20M)/ac(20M) 5.8G	149	—	165
	WLAN802.11 n(40M)/ac(40M) 5.8G	142	—	159
	WLAN802.11 ac(80M) 5.8G	155		
	Bluetooth	0	—	78

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Max. Body SAR (1 g) (Unit: W/Kg)					
Antenna	Band	Measured	Reported	Channel	Position
Tx1	WLAN802.11b	0.01	0.01	6	3-1
	Bluetooth (GFSK)	0.00	0.00	78	3-1
	WLAN802.11 a 5.2G	0.05	0.05	48	3-1
	WLAN802.11 a 5.3G	0.04	0.04	56	3-1
	WLAN802.11 a 5.6G	0.06	0.06	136	3-1
	WLAN802.11 a 5.8G	0.06	0.06	149	3-1
Tx2	WLAN802.11b	0.02	0.02	6	3-1
	WLAN802.11 a 5.2G	0.12	0.12	48	3-1
	WLAN802.11 a 5.3G	0.14	0.14	56	3-1
	WLAN802.11 a 5.6G	0.06	0.06	116	3-1
	WLAN802.11 a 5.8G	0.07	0.07	165	3-1

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Max. Extremity SAR (10 g) (Unit: W/Kg)					
Antenna	Band	Measured	Reported	Channel	Position
Tx1	WLAN802.11b	0.44	0.46	6	2-3
	Bluetooth (GFSK)	0.01	0.01	78	2-3
	WLAN802.11 a 5.2G	0.86	0.86	48	2-3
	WLAN802.11 a 5.3G	0.72	0.72	56	2-3
	WLAN802.11 a 5.6G	1.19	1.19	136	2-3
	WLAN802.11 a 5.8G	1.18	1.18	149	2-3
Tx2	WLAN802.11b	0.69	0.71	6	1
	WLAN802.11 a 5.2G	0.73	0.73	48	1
	WLAN802.11 a 5.3G	0.78	0.79	52	1
	WLAN802.11 a 5.6G	0.64	0.64	116	1
	WLAN802.11 a 5.8G	0.64	0.64	165	1

Antenna Information

Vendor	INPAQ					INPAQ				
Antenna	Main(Tx2/Ant2)					Aux(Tx1/Ant1)				
Part Number	DQ60PLB0245(WA-P-LB-02-644)					DQ60PLB0244(WA-P-LB-02-643)				
Frequency	2.4G	5.2G	5.3G	5.5G	5.8G	2.4G	5.2G	5.3G	5.5G	5.8G
Gain (dBi)	-1.55	-1.21	-0.42	0.45	-0.51	1.14	-0.75	-0.75	-0.19	0.39

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WLAN802.11 a/b/g/n(20M/40M)/ac(20M/40M/80M) conducted power table:

Band \ Antenna	SISO		2TX / 2TX CDD
	Chain 0	Chain 1	Chain0+1
WLAN802.11b	V	V	—
WLAN802.11g	V	V	V
WLAN802.11n(20M)	V	V	V
WLAN802.11n(40M)	V	V	V
WLAN802.11a	V	V	V
WLAN802.11n(20M) 5G	V	V	V
WLAN802.11n(40M) 5G	V	V	V
WLAN802.11ac(20M) 5G	V	V	V
WLAN802.11ac(40M) 5G	V	V	V
WLAN802.11ac(80M) 5G	V	V	V

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Tx1

Tx1(B port) Antenna						
Band	Mode	Channel	Frequency (MHz)	Data Rate	Max. Rated Avg. Power + Max. Tolerance (dBm)	Average power (dBm)
2450 MHz	802.11b	1	2412	1Mbps	17.00	16.94
		2	2417		17.00	16.96
		6	2437		17.00	16.82
		10	2457		17.00	16.81
		11	2462		17.00	16.87
		12	2467		14.00	13.82
		13	2472		11.00	11.00
	802.11g	1	2412	6Mbps	14.00	13.91
		2	2417		16.00	15.98
		6	2437		18.00	17.98
		10	2457		16.00	15.96
		11	2462		15.00	14.86
		12	2467		12.00	11.97
		13	2472		8.00	7.82
	802.11n20-HT0	1	2412	MCS0	14.00	14.00
		2	2417		16.00	15.94
		6	2437		18.00	17.92
		10	2457		16.00	15.89
		11	2462		14.00	13.82
		12	2467		11.00	10.87
		13	2472		8.00	7.97
	802.11n40-HT0	3	2422	MCS0	14.00	13.88
		4	2427		14.00	13.92
		6	2437		17.00	16.81
		8	2447		14.00	13.98
		9	2452		14.00	13.86
		10	2457		11.00	11.00
		11	2462		8.00	7.92

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Tx1(B port) Antenna						
Band	Mode	Channel	Frequency (MHz)	Data Rate	Max. Rated Avg. Power + Max. Tolerance (dBm)	Average power (dBm)
5.15-5.25 GHz	802.11a	36	5180	6Mbps	16.50	16.48
		40	5200		17.50	17.49
		44	5220		17.50	17.46
		48	5240		17.50	17.50
	802.11n20-HT0	36	5180	MCS0	16.50	16.42
		40	5200		17.50	17.37
		44	5220		17.50	17.42
		48	5240		17.50	17.39
	802.11ac20-VHT0	36	5180	MCS0	16.50	16.49
		40	5200		17.50	17.43
		44	5220		17.50	17.37
		48	5240		17.50	17.38
	802.11n40-HT0	38	5190	MCS0	12.50	12.37
		46	5230		16.50	16.40
	802.11ac40-VHT0	38	5190	MCS0	12.50	12.40
		46	5230		16.50	16.38
802.11ac80-VHT0	42	5210	MCS0	11.50	11.39	

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Tx1(B port) Antenna						
Band	Mode	Channel	Frequency (MHz)	Data Rate	Max. Rated Avg. Power + Max. Tolerance (dBm)	Average power (dBm)
5.25-5.35 GHz	802.11a	52	5260	6Mbps	17.50	17.45
		56	5280		17.50	17.49
		60	5300		17.50	17.46
		64	5320		15.50	15.49
	802.11n20-HT0	52	5260	MCS0	17.50	17.34
		56	5280		17.50	17.33
		60	5300		17.50	17.44
		64	5320		15.50	15.33
	802.11ac20-VHT0	52	5260	MCS0	17.50	17.31
		56	5280		17.50	17.48
		60	5300		17.50	17.43
		64	5320		15.50	15.41
	802.11n40-HT0	54	5270	MCS0	16.50	16.47
		62	5310		13.50	13.45
	802.11ac40-VHT0	54	5270	MCS0	16.50	16.50
		62	5310		13.50	13.43
	802.11ac80-VHT0	58	5290	MCS0	11.50	11.45

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Tx1(B port) Antenna						
Band	Mode	Channel	Frequency (MHz)	Data Rate	Max. Rated Avg. Power + Max. Tolerance (dBm)	Average power (dBm)
5600 MHz	802.11a	100	5500	6Mbps	14.50	14.42
		104	5520		17.50	17.44
		116	5580		17.50	17.49
		120	5600		17.50	17.48
		136	5680		17.50	17.50
		140	5700		15.50	15.43
		144	5720		15.50	15.46
	802.11n20-HT0	100	5500	MCS0	14.50	14.34
		104	5520		17.50	17.48
		116	5580		17.50	17.31
		120	5600		17.50	17.32
		136	5680		17.50	17.41
		140	5700		14.50	14.32
		144	5720		14.50	14.40
	802.11ac20-VHT0	100	5500	MCS0	14.50	14.43
		104	5520		17.50	17.43
		116	5580		17.50	17.38
		120	5600		17.50	17.33
		136	5680		17.50	17.36
		140	5700		14.50	14.38
		144	5720		14.50	14.35
	802.11n40-HT0	102	5510	MCS0	13.50	13.50
		110	5550		16.50	16.42
		118	5590		16.50	16.49
		134	5670		16.50	16.36
		142	5710		16.50	16.50
	802.11ac40-VHT0	102	5510	MCS0	13.50	13.32
		110	5550		16.50	16.40
		118	5590		16.50	16.39
		134	5670		16.50	16.39
142		5710	16.50		16.38	
802.11ac80-VHT0	106	5530	MCS0	11.50	11.46	
	122	5610		16.50	16.35	
	138	5690		16.50	16.35	

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Tx1(B port) Antenna						
Mode	Mode	Channel	Frequency (MHz)	Data Rate	Max. Rated Avg. Power + Max. Tolerance (dBm)	Average power (dBm)
5800 MHz	802.11a	149	5745	6Mbps	17.50	17.50
		157	5785		17.50	17.48
		165	5825		17.50	17.46
	802.11n20-HT0	149	5745	MCS0	17.50	17.42
		157	5785		17.50	17.49
		165	5825		17.50	17.48
	802.11ac20-VHT0	149	5745	MCS0	17.50	17.40
		157	5785		17.50	17.38
		165	5825		17.50	17.34
	802.11n40-HT0	151	5755	MCS0	16.50	16.46
		159	5795		16.50	16.32
	802.11ac40-VHT0	151	5755	MCS0	16.50	16.44
		159	5795		16.50	16.36
	802.11ac80-VHT0	155	5775	MCS0	16.50	16.33

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Tx2

Tx2(A port) Antenna						
Band	Mode	Channel	Frequency (MHz)	Data Rate	Max. Rated Avg. Power + Max. Tolerance (dBm)	Average power (dBm)
2450 MHz	802.11b	1	2412	1Mbps	17.00	16.86
		2	2417		17.00	16.89
		6	2437		17.00	16.91
		10	2457		17.00	16.86
		11	2462		17.00	16.91
		12	2467		14.00	13.81
		13	2472		11.00	10.94
	802.11g	1	2412	6Mbps	14.00	13.97
		2	2417		16.00	15.96
		6	2437		18.00	17.98
		10	2457		16.00	15.88
		11	2462		15.00	15.00
		12	2467		12.00	11.89
	802.11n20-HT0	1	2412	MCS0	14.00	13.81
		2	2417		16.00	16.00
		6	2437		18.00	17.87
		10	2457		16.00	15.90
		11	2462		14.00	13.88
		12	2467		11.00	10.81
	802.11n40-HT0	3	2422	MCS0	14.00	13.98
		4	2427		14.00	13.93
		6	2437		17.00	16.86
		8	2447		14.00	13.82
		9	2452		14.00	13.98
		10	2457		11.00	10.81
		11	2462		8.00	7.89

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Tx2(A port) Antenna						
Band	Mode	Channel	Frequency (MHz)	Data Rate	Max. Rated Avg. Power + Max. Tolerance (dBm)	Average power (dBm)
5.15-5.25 GHz	802.11a	36	5180	6Mbps	16.50	16.49
		40	5200		17.50	17.42
		44	5220		17.50	17.47
		48	5240		17.50	17.50
	802.11n20-HT0	36	5180	MCS0	16.50	16.36
		40	5200		17.50	17.43
		44	5220		17.50	17.35
		48	5240		17.50	17.35
	802.11ac20-VHT0	36	5180	MCS0	16.50	16.45
		40	5200		17.50	17.36
		44	5220		17.50	17.34
		48	5240		17.50	17.42
	802.11n40-HT0	38	5190	MCS0	12.50	12.31
		46	5230		16.50	16.48
	802.11ac40-VHT0	38	5190	MCS0	12.50	12.38
		46	5230		16.50	16.42
802.11ac80-VHT0	42	5210	MCS0	11.50	11.31	

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Tx2(A port) Antenna						
Band	Mode	Channel	Frequency (MHz)	Data Rate	Max. Rated Avg. Power + Max. Tolerance (dBm)	Average power (dBm)
5.25-5.35 GHz	802.11a	52	5260	6Mbps	17.50	17.48
		56	5280		17.50	17.49
		60	5300		17.50	17.46
		64	5320		15.50	15.47
	802.11n20-HT0	52	5260	MCS0	17.50	17.37
		56	5280		17.50	17.44
		60	5300		17.50	17.34
		64	5320		15.50	15.49
	802.11ac20-VHT0	52	5260	MCS0	17.50	17.38
		56	5280		17.50	17.45
		60	5300		17.50	17.32
		64	5320		15.50	15.35
	802.11n40-HT0	54	5270	MCS0	16.50	16.47
		62	5310		13.50	13.38
	802.11ac40-VHT0	54	5270	MCS0	16.50	16.32
		62	5310		13.50	13.33
	802.11ac80-VHT0	58	5290	MCS0	11.50	11.49

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Tx2(A port) Antenna						
Band	Mode	Channel	Frequency (MHz)	Data Rate	Max. Rated Avg. Power + Max. Tolerance (dBm)	Average power (dBm)
5600 MHz	802.11a	100	5500	6Mbps	14.50	14.47
		104	5520		17.50	17.48
		116	5580		17.50	17.49
		120	5600		17.50	17.48
		136	5680		17.50	17.46
		140	5700		15.50	15.50
		144	5720		15.50	15.31
	802.11n20-HT0	100	5500	MCS0	14.50	14.41
		104	5520		17.50	17.41
		116	5580		17.50	17.44
		120	5600		17.50	17.45
		136	5680		17.50	17.36
		140	5700		14.50	14.48
		144	5720		14.50	14.31
	802.11ac20-VHT0	100	5500	MCS0	14.50	14.31
		104	5520		17.50	17.39
		116	5580		17.50	17.42
		120	5600		17.50	17.31
		136	5680		17.50	17.45
		140	5700		14.50	14.35
		144	5720		14.50	14.33
	802.11n40-HT0	102	5510	MCS0	13.50	13.44
		110	5550		16.50	16.31
		118	5590		16.50	16.46
		134	5670		16.50	16.38
		142	5710		16.50	16.37
	802.11ac40-VHT0	102	5510	MCS0	13.50	13.38
		110	5550		16.50	16.33
		118	5590		16.50	16.37
		134	5670		16.50	16.33
142		5710	16.50		16.44	
802.11ac80-VHT0	106	5530	MCS0	11.50	11.40	
	122	5610		16.50	16.40	
	138	5690		16.50	16.34	

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Tx2(A port) Antenna						
Mode	Mode	Channel	Frequency (MHz)	Data Rate	Max. Rated Avg. Power + Max. Tolerance (dBm)	Average power (dBm)
5800 MHz	802.11a	149	5745	6Mbps	17.50	17.45
		157	5785		17.50	17.47
		165	5825		17.50	17.50
	802.11n20-HT0	149	5745	MCS0	17.50	17.40
		157	5785		17.50	17.40
		165	5825		17.50	17.39
	802.11ac20-VHT0	149	5745	MCS0	17.50	17.31
		157	5785		17.50	17.44
		165	5825		17.50	17.41
	802.11n40-HT0	151	5755	MCS0	16.50	16.36
		159	5795		16.50	16.47
	802.11ac40-VHT0	151	5755	MCS0	16.50	16.45
		159	5795		16.50	16.48
	802.11ac80-VHT0	155	5775	MCS0	16.50	16.44

Bluetooth conducted power table:

Mode	Channel	Frequency (MHz)	Average Output Power (dBm)			Max. Rated Avg. Power + Max. Tolerance (dBm)
			1Mbps	2Mbps	3Mbps	
BR/EDR	CH 00	2402	5.46	5.35	5.37	5.5
	CH 39	2441	5.48	5.38	5.41	
	CH 78	2480	5.49	5.41	5.44	

Mode	Channel	Frequency (MHz)	Average Output Power (dBm)	Max. Rated Avg. Power + Max. Tolerance (dBm)
			GFSK	
LE	CH 00	2402	5.33	5.5
	CH 19	2440	5.34	
	CH 39	2480	5.38	

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1.4 Test Environment

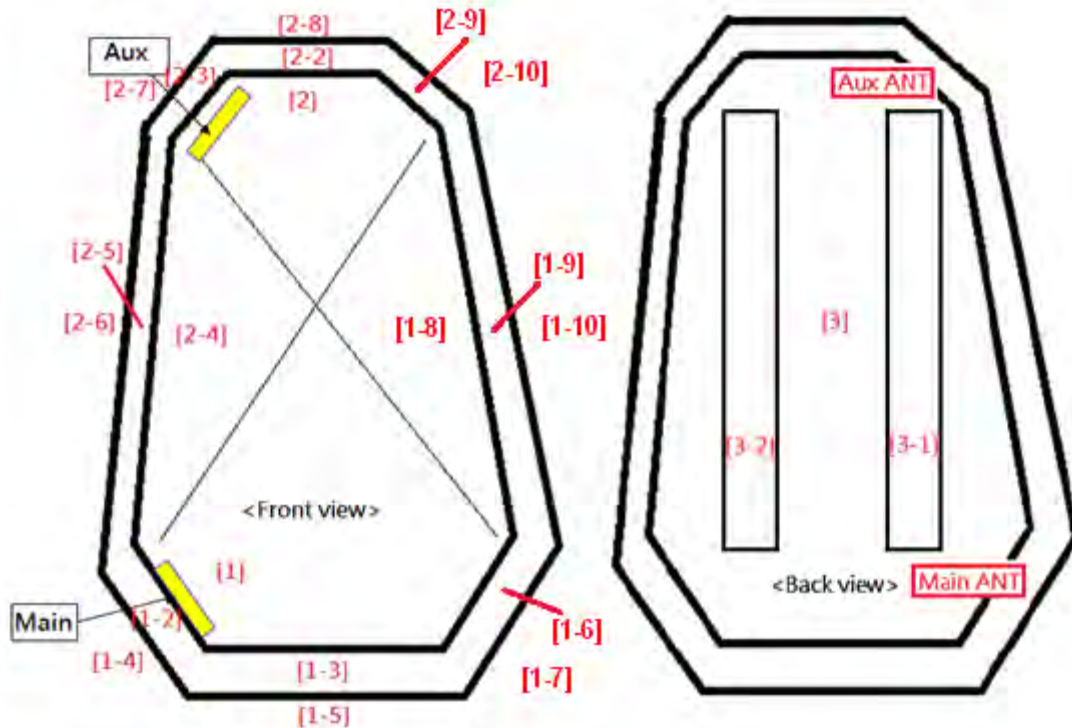
Ambient Temperature: 22±2° C
Tissue Simulating Liquid: 22±2° C

1.5 Operation Description

Use chipset specific software to control the EUT, and makes it transmit in maximum power. Measurements are performed respectively on the lowest, middle and highest channels of the operating band(s). The EUT is set to maximum power level during all tests, and at the beginning of each test the battery is fully charged.

EUT was tested as below base on KDB inquiry

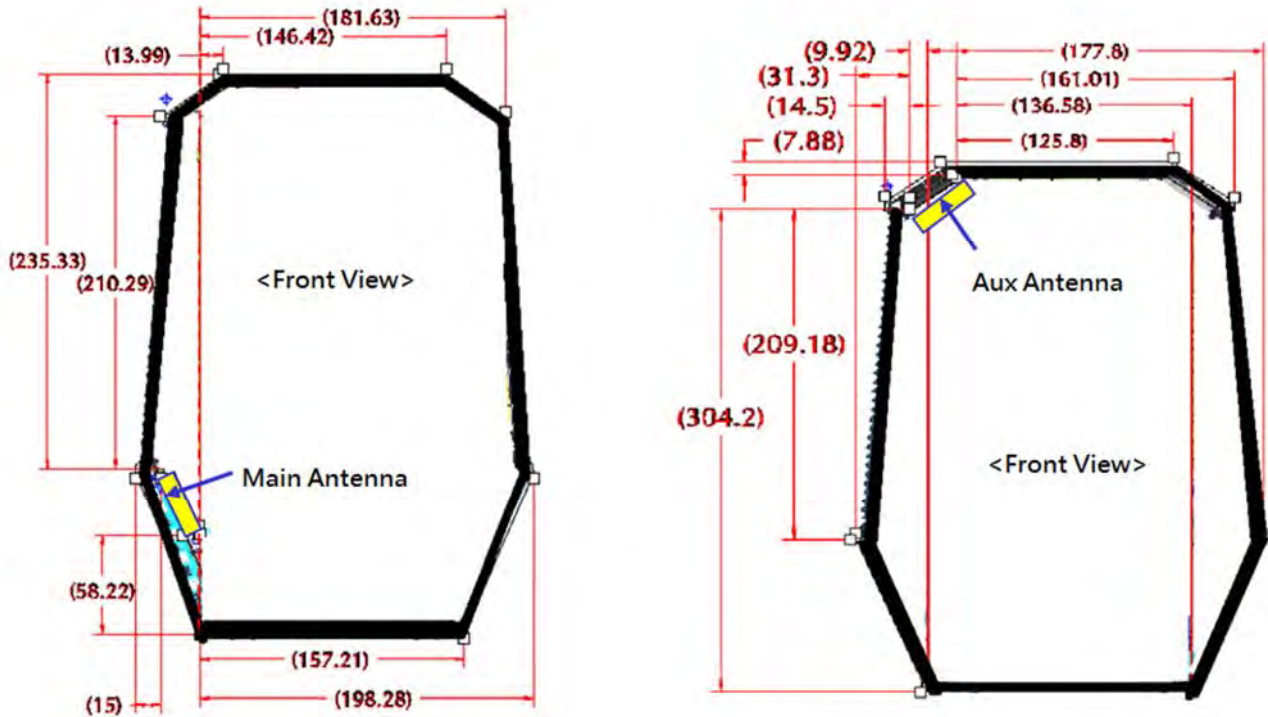
Antennas	tested surfaces	Body SAR_0mm (1g-SAR<1.6W/Kg)	Extremity SAR_0mm (10g-SAR<4W/Kg)
Main and Aux	3-1,	required	not required
Aux (Tx1)	2, 2-2, 2-3, 2-4, 2-5, 2-6, 2-7, 2-8	not required	required
Main (Tx2)	1, 1-2, 1-4, 2-4, 2-5, 2-6	not required	required



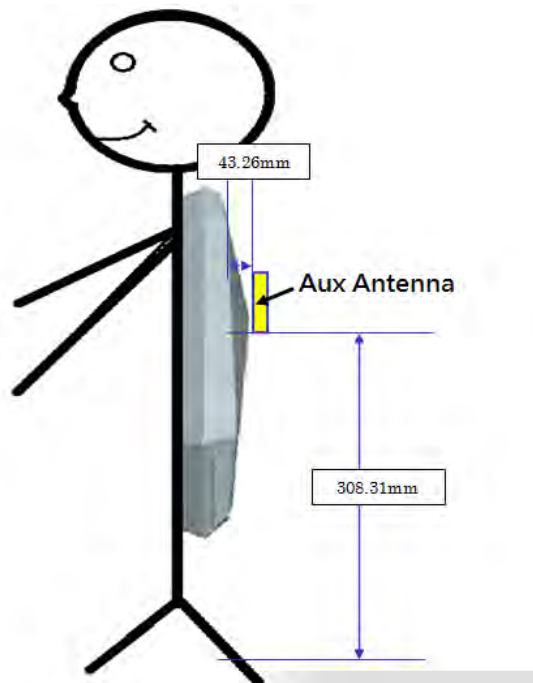
Antenna location of EUT

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Antenna Location of EUT (Unit: mm)



Antenna Location of EUT

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Note:

802.11b DSSS SAR Test Requirements:

1. SAR is measured for 2.4 GHz 802.11b DSSS mode using the highest measured maximum output power channel, when the reported SAR of the highest measured maximum output power channel for the exposure configuration is ≤ 0.8 W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.
2. When the reported SAR is > 0.8 W/kg, SAR is required for that exposure configuration using the next highest measured output power channel. When any reported SAR is > 1.2 W/kg, SAR is required for the third channel; i.e., all channels require testing.

802.11g/n OFDM SAR Test Exclusion Requirements:

3. SAR is not required for 802.11g/n since the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.

Initial Test Configuration:

4. An initial test configuration is determined for OFDM transmission modes according to the channel bandwidth, modulation and data rate combination(s) with the highest maximum output power specified for production units in each standalone and aggregated frequency band.
5. SAR is measured using the highest measured maximum output power channel. When the reported SAR of the initial test configuration is > 0.8 W/kg, SAR measurement is required for the subsequent next highest measured output power channel(s) in the initial test configuration until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.
6. For WLAN Main/Aux antennas, 5.2a/5.3a/5.6a/5.8a is chosen to be the initial test configurations.
7. Since the highest reported SAR for the initial test configuration is adjusted by the ratio of the subsequent test configuration to initial test configuration specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg, SAR is not required for subsequent test configuration.
8. Based on KDB248227 D01, while 1-g SAR thresholds are specified in the procedures for SAR test reduction and exclusion, these thresholds should be

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multiplied by 2.5 when 10-g extremity SAR is considered.

9. BT and WLAN Tx1 use the same antenna path, but they can't transmit at the same time.
10. According to KDB447498 D01, testing of other required channels is not required when the reported 1-g SAR (or 10-g SAR) for the highest output channel is ≤ 0.8 W/kg (or ≤ 2 W/kg), when the transmission band is ≤ 100 MHz.
11. According to KDB865664 D01, SAR measurement variability must be assessed for each frequency band. When the original highest measured SAR is ≥ 0.8 W/kg, repeated that measurement once. Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or when the original or repeated measurement is ≥ 1.45 W/kg (~10% from the 1-g SAR limit). The same procedures should be adapted for measurements according to extremity and occupational exposure limits by applying a factor of 2.5 for extremity exposure and a factor of 5 for occupational exposure to the corresponding SAR thresholds.
12. Based on KDB447498D01,
 - (1) SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by: [(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] $\cdot [\sqrt{f}(\text{GHz})] \leq 3.0$ for 1-g SAR, and ≤ 7.5 for 10-g extremity SAR,

When the minimum test separation distance is $< 5\text{mm}$, 5mm is applied to determine SAR test exclusion.

Mode	Position	Max. Power (dBm)	f(GHz)	Calculation	SAR exclusion threshold	SAR test exclusion
BT	Body	5.5	2.48	1.118	3	yes
BT	Extremity	5.5	2.48	1.118	7.5	yes

- (2) For test separation distances > 50 mm, and the frequency at 100 MHz to 1500MHz, the SAR test exclusion threshold is determined according to the following, and as illustrated in Appendix B of KDB447498 D01.

$$\left[(\text{Threshold at } 50\text{mm in step1}) + (\text{test separation distance}-50\text{mm}) \times \left(\frac{f(\text{MHz})}{150} \right) \right] \text{ (mW)},$$

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- (3) For test separation distances > 50 mm, and the frequency at >1500MHz to 6GHz, the SAR test exclusion threshold is determined according to the following, and as illustrated in Appendix B of KDB447498 D01.

[(Threshold at 50mm in step1) + (test separation distance-50mm)x10](mW),

Mode		WLAN Main 2.45GHz	WLAN Main 5GHz
Max. tune-up power (dBm)		18	17.5
Max. tune-up power (mW)		63.10	56.23
Use highest frequency for test exclusion threshold calculation (worst case)		2462MHz	5825MHz
1-3	Test separation distance (mm)	58.22	58.22
	SAR test exclusion threshold (mW)	321.20	237.58
	Require SAR testing?	NO	NO
1-5	Test separation distance (mm)	58.22	58.22
	SAR test exclusion threshold	321.20	237.58
	Require SAR testing?	NO	NO
2	Test separation distance (mm)	227.45	227.45
	>20cm	YES	YES
	Require SAR testing?	NO	NO
2-2	Test separation distance (mm)	227.45	227.45
	>20cm	YES	YES
	Require SAR testing?	NO	NO
2-3	Test separation distance (mm)	210.29	210.29
	>20cm	YES	YES
	Require SAR testing?	NO	NO
2-7	Test separation distance (mm)	210.29	210.29
	>20cm	YES	YES
	Require SAR testing?	NO	NO
2-8	Test separation distance (mm)	235.33	235.33
	>20cm	YES	YES
	Require SAR testing?	NO	NO

Mode		WLAN Main 2.45GHz	WLAN Main 5GHz
Max. tune-up power (dBm)		18	17.5
Max. tune-up power (mW)		63.10	56.23
Use highest frequency for test exclusion threshold calculation (worst case)		2462MHz	5825MHz
2-9	Test separation distance (mm)	277.16	277.16
	>20cm	YES	YES
	Require SAR testing?	NO	NO
2-10	Test separation distance (mm)	277.16	277.16
	>20cm	YES	YES
	Require SAR testing?	NO	NO
1-6	Test separation distance (mm)	157.21	157.21
	SAR test exclusion threshold (mW)	1311.10	1227.50
	Require SAR testing?	NO	NO
1-7	Test separation distance (mm)	157.21	157.21
	SAR test exclusion threshold	1311.10	1227.50
	Require SAR testing?	NO	NO
1-8	Test separation distance (mm)	198.28	198.28
	SAR test exclusion threshold (mW)	1721.80	1638.20
	Require SAR testing?	NO	NO
1-9	Test separation distance (mm)	198.28	198.28
	SAR test exclusion threshold	1721.80	1638.20
	Require SAR testing?	NO	NO
1-10	Test separation distance (mm)	198.28	198.28
	SAR test exclusion threshold (mW)	1721.80	1638.20
	Require SAR testing?	NO	NO

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Mode	WLAN Aux 2.45GHz	WLAN Aux 5GHz	BT Aux	
Max. tune-up power (dBm)	18	17.5	5.5	
Max. tune-up power (mW)	63.10	56.23	3.55	
Use highest frequency for test exclusion threshold calculation (worst case)	2462MHz	5825MHz	2480MHz	
1	Test separation distance (mm)	209.18	209.18	209.18
	>20cm	YES	YES	YES
	Require SAR testing?	NO	NO	NO
1-2	Test separation distance (mm)	209.18	209.18	209.18
	>20cm	YES	YES	YES
	Require SAR testing?	NO	NO	NO
1-3	Test separation distance (mm)	> 209.18	> 209.18	> 209.18
	>20cm	YES	YES	YES
	Require SAR testing?	NO	NO	NO
1-4	Test separation distance (mm)	209.18	209.18	209.18
	>20cm	YES	YES	YES
	Require SAR testing?	NO	NO	NO
1-5	Test separation distance (mm)	302.4	302.4	302.4
	>20cm	YES	YES	YES
	Require SAR testing?	NO	NO	NO
1-6	Test separation distance (mm)	274.5	274.5	274.5
	>20cm	YES	YES	YES
	Require SAR testing?	NO	NO	NO

Mode	WLAN Aux 2.45GHz	WLAN Aux 5GHz	BT Aux	
Max. tune-up power (dBm)	18	17.5	5.5	
Max. tune-up power (mW)	63.10	56.23	3.55	
Use highest frequency for test exclusion threshold calculation (worst case)	2462MHz	5825MHz	2480MHz	
1-7	Test separation distance (mm)	274.5	274.5	274.5
	>20cm	YES	YES	YES
	Require SAR testing?	NO	NO	NO
1-8	Test separation distance (mm)	161.01	161.01	161.01
	SAR test exclusion threshold (mW)	1349.10	1265.48	1348.22
	Require SAR testing?	NO	NO	NO
1-9	Test separation distance (mm)	161.01	161.01	161.01
	SAR test exclusion threshold (mW)	1349.10	1265.48	1348.22
	Require SAR testing?	NO	NO	NO
1-10	Test separation distance (mm)	161.01	161.01	161.01
	SAR test exclusion threshold (mW)	1349.10	1265.48	1348.22
	Require SAR testing?	NO	NO	NO
2-9	Test separation distance (mm)	125.8	125.8	125.8
	SAR test exclusion threshold (mW)	997.00	913.38	996.12
	Require SAR testing?	NO	NO	NO
2-10	Test separation distance (mm)	125.8	125.8	125.8
	SAR test exclusion threshold (mW)	997.00	913.38	996.12
	Require SAR testing?	NO	NO	NO

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1.6 The SAR Measurement System

A block diagram of the SAR measurement System is given in Fig. a. This SAR Measurement System uses a Computer-controlled 3-D stepper motor system (SPEAG DASY 5 professional system). The model EX3DV4 field probe is used to determine the internal electric fields. The SAR can be obtained from the equation $SAR = \sigma (|E_{i}|^2) / \rho$ where σ and ρ are the conductivity and mass density of the tissue-simulant.

The DASY 5 system for performing compliance tests consists of the following items:

1. A standard high precision 6-axis robot (Staubli RX family) with controller, teach pendant and software. An arm extension is for accommodating the data acquisition electronics (DAE).
2. A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage intissue simulating liquid. The probe is equipped with an optical surface detector system.
3. A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.

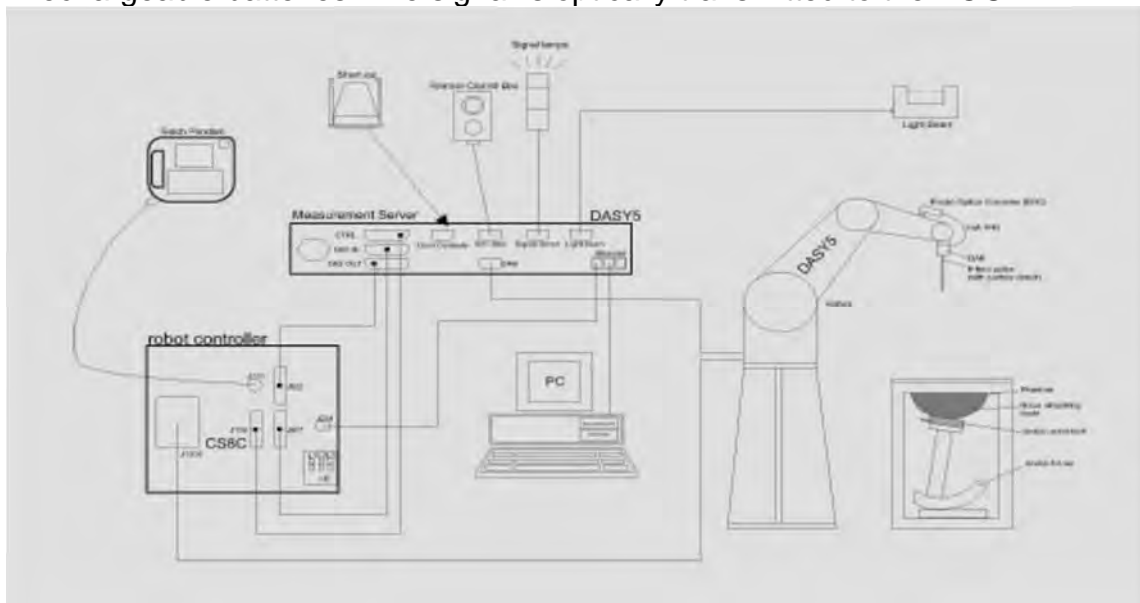


Fig. a The block diagram of SAR system

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4. The Electro-optical converter (EOC) performs the conversion between optical and electrical of the signals for the digital communication to the DAE and for the analog signal from the optical surface detection. The EOC is connected to the measurement server.
5. The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
6. A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
7. A computer operating Windows 7.
8. DASY 5 software.
9. Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
10. The SAM twin phantom enabling testing left-hand and right-hand usage.
11. The device holder for handheld mobile phones.
12. Tissue simulating liquid mixed according to the given recipes.
13. Validation dipole kits allowing to validate the proper functioning of the system.

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1.7 System Components


EX3DV4 E-Field Probe

Construction	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)	
Calibration	Basic Broad Band Calibration in air Conversion Factors (CF) for HSL 2450/5200/5300/5600/5800 MHz Additional CF for other liquids and frequencies upon request	
Frequency	10 MHz to > 6 GHz	
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)	
Dynamic Range	10 µW/g to > 100 mW/g Linearity: ± 0.2 dB (noise: typically < 1 µW/g)	
Dimensions	Tip diameter: 2.5 mm	
Application	High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better 30%.	


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PHANTOM

Model	ELI	
Construction	The ELI phantom is used 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.	
Shell Thickness	2 ± 0.2 mm	
Filling Volume	Approx. 30 liters	
Dimensions	Major axis: 600 mm Minor axis: 400 mm	

DEVICE HOLDER

Construction	The device holder (Supporter) for Notebook is made by POM (polyoxymethylene resin) , which is non-metal and non-conductive. The height can be adjusted to fit varies kind of notebooks.	
		Device Holder

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1.8 SAR System Verification

The microwave circuit arrangement for system verification is sketched in Fig. b. The daily system accuracy verification occurs within the flat section of the SAM phantom. A SAR measurement was performed to see if the measured SAR was within +/- 10% from the target SAR values. These tests were done at 2450/5200/5300/5600/5800 MHz. The tests were conducted on the same days as the measurement of the DUT. The obtained results from the system accuracy verification are displayed in the table 1 (SAR values are normalized to 1W forward power delivered to the dipole). During the tests, the liquid depth was $\geq 15 \text{ cm} \pm 5 \text{ mm}$ (frequency $\leq 3 \text{ GHz}$) or $\geq 10 \text{ cm} \pm 5 \text{ mm}$ (frequency $> 3 \text{ GHz}$) in all the cases. It is seen that the system is operating within its specification, as the results are within acceptable tolerance of the reference values.

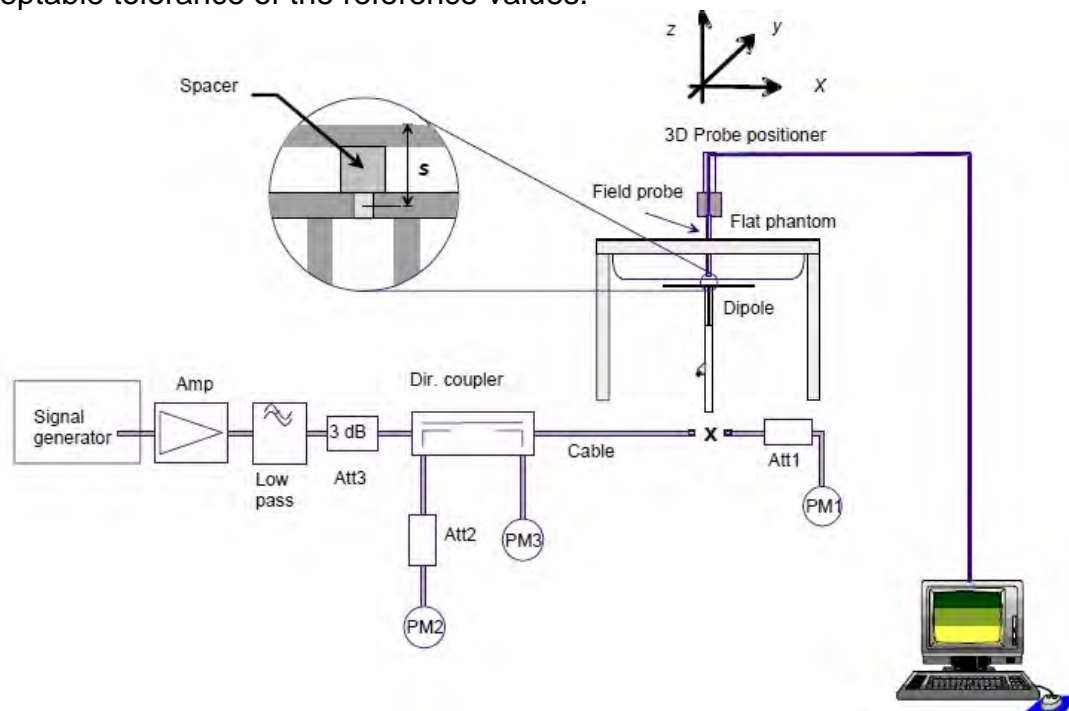


Fig. b The block diagram of system verification

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Validation Kit	S/N	Frequency (MHz)		1W Target SAR-1g (mW/g)	Measured SAR-1g (mW/g)	Measured SAR-1g normalized to 1W (mW/g)	Deviation (%)	Measured Date
D2450V2	727	2450	Body	50.8	12.60	50.40	-0.79%	Mar. 20, 2019
Validation Kit	S/N	Frequency (MHz)		1W Target SAR-1g (mW/g)	Measured SAR-1g (mW/g)	Measured SAR-1g normalized to 1W (mW/g)	Deviation (%)	Measured Date
D5GHzV2	1040	5200	Body	75.2	7.20	72.00	-4.26%	Mar. 21, 2019
		5300	Body	76.4	7.49	74.90	-1.96%	Mar. 22, 2019
		5600	Body	81.5	7.84	78.40	-3.80%	Mar. 23, 2019
		5800	Body	77.3	7.57	75.70	-2.07%	Mar. 24, 2019
Validation Kit	S/N	Frequency (MHz)		1W Target SAR-10g (mW/g)	pin=250mW Measured SAR-10g (mW/g)	Measured SAR-10g normalized to 1W (mW/g)	Deviation (%)	Measured Date
D2450V2	727	2450	Body	23.8	5.76	23.04	-3.19%	Mar. 20, 2019
Validation Kit	S/N	Frequency (MHz)		1W Target SAR-10g (mW/g)	pin=100mW Measured SAR-10g (mW/g)	Measured SAR-10g normalized to 1W (mW/g)	Deviation (%)	Measured Date
D5GHzV2	1040	5200	Body	20.9	1.99	19.90	-4.78%	Mar. 21, 2019
		5300	Body	21.4	2.09	20.90	-2.34%	Mar. 22, 2019
		5600	Body	22.7	2.17	21.70	-4.41%	Mar. 23, 2019
		5800	Body	21.3	2.09	20.90	-1.88%	Mar. 24, 2019

Table 1. Results of system verification

1.9 Tissue Simulant Fluid for the Frequency Band

The dielectric properties for this body-simulant fluid were measured by using the Agilent Model 85070E Dielectric Probe (rates frequency band 200 MHz to 20 GHz) in conjunction with Network Analyzer. All dielectric parameters of tissue simulates were measured within 24 hours of SAR measurements. The measured conductivity and permittivity are all within $\pm 5\%$ of the target values.

The depth of the tissue simulant in the flat section of the phantom was $\geq 15 \text{ cm} \pm 5 \text{ mm}$ (Frequency $\leq 3\text{G}$) or $\geq 10 \text{ cm} \pm 5 \text{ mm}$ (Frequency $> 3\text{G}$) during all tests. (Fig. 2)

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Tissue Type	Measurement Date	Measured Frequency (MHz)	Target Dielectric Constant, ϵ_r	Target Conductivity, σ (S/m)	Measured Dielectric Constant, ϵ_r	Measured Conductivity, σ (S/m)	% dev ϵ_r	% dev σ
Body	Mar, 20. 2019	2402	52.764	1.904	51.188	1.954	-2.99%	2.62%
		2412	52.751	1.914	51.144	1.965	-3.05%	2.68%
		2417	52.744	1.918	51.120	1.973	-3.08%	2.87%
		2427	52.731	1.928	51.061	1.990	-3.17%	3.22%
		2437	52.717	1.938	51.014	2.004	-3.23%	3.43%
		2441	52.712	1.941	51.005	2.007	-3.24%	3.38%
		2447	52.704	1.947	50.981	2.014	-3.27%	3.43%
		2450	52.700	1.950	50.971	2.019	-3.28%	3.54%
		2457	52.691	1.960	50.943	2.029	-3.32%	3.52%
		2462	52.685	1.967	50.924	2.035	-3.34%	3.46%
	2480	52.662	1.993	50.885	2.060	-3.37%	3.39%	
	Mar, 21. 2019	5180	49.041	5.276	49.249	5.153	0.42%	-2.33%
		5190	49.028	5.288	49.169	5.157	0.29%	-2.48%
		5200	49.014	5.299	49.156	5.164	0.29%	-2.55%
		5210	49.001	5.311	49.093	5.184	0.19%	-2.39%
		5220	48.987	5.323	49.090	5.191	0.21%	-2.48%
		5230	48.974	5.334	49.020	5.227	0.09%	-2.01%
		5240	48.960	5.346	48.989	5.231	0.06%	-2.15%
	Mar, 21. 2019	5260	48.933	5.369	48.904	5.271	-0.06%	-1.83%
		5270	48.919	5.381	48.895	5.292	-0.05%	-1.65%
		5280	48.906	5.393	48.863	5.305	-0.09%	-1.63%
		5300	48.879	5.416	48.827	5.331	-0.11%	-1.57%
		5310	48.865	5.428	48.775	5.350	-0.18%	-1.43%
		5320	48.851	5.439	48.732	5.363	-0.24%	-1.40%
	Mar, 21. 2019	5500	48.607	5.650	48.205	5.666	-0.83%	0.28%
		5510	48.594	5.661	48.133	5.668	-0.95%	0.12%
		5520	48.580	5.673	48.125	5.688	-0.94%	0.26%
		5530	48.566	5.685	48.059	5.702	-1.04%	0.30%
		5550	48.539	5.708	47.981	5.738	-1.15%	0.53%
		5580	48.499	5.743	47.915	5.793	-1.20%	0.87%
		5590	48.485	5.755	47.884	5.821	-1.24%	1.15%
		5600	48.471	5.766	47.871	5.824	-1.24%	1.00%
		5610	48.458	5.778	47.844	5.829	-1.27%	0.88%
		5670	48.376	5.848	47.653	5.940	-1.50%	1.57%
		5680	48.363	5.860	47.631	5.963	-1.51%	1.76%
		5690	48.349	5.872	47.601	5.991	-1.55%	2.03%
	Mar, 20. 2019	5710	48.322	5.895	47.538	6.003	-1.62%	1.83%
		5720	48.309	5.907	47.515	6.013	-1.64%	1.79%
		5775	48.234	5.971	47.315	6.114	-1.91%	2.40%
		5800	48.200	6.000	47.243	6.167	-1.99%	2.78%
		5825	48.166	6.029	47.228	6.184	-1.95%	2.57%

Table 2. Dielectric Parameters of Tissue Simulant Fluid

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The composition of the tissue simulating liquid:

Frequency (MHz)	Mode	Ingredient						Total amount
		DGMBE	Water	Salt	Preventol D-7	Cellulose	Sugar	
2450M	Body	301.7ml	698.3ml	—	—	—	—	1.0L(Kg)

Body Simulating Liquids for 5 GHz, Manufactured by SPEAG:

Ingredients	Water	Esters, Emulsifiers, Inhibitors	Sodium and Salt
(% by weight)	60-80	20-40	0-1.5

Table 3. Recipes for Tissue Simulating Liquid

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1.10 Evaluation Procedures

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 1 g and 10 g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

1. The extraction of the measured data (grid and values) from the Zoom Scan.
2. The calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
3. The generation of a high-resolution mesh within the measured volume
4. The interpolation of all measured values from the measurement grid to the high-resolution grid
5. The extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
6. The calculation of the averaged SAR within masses of 1g and 10g.

The probe is calibrated at the center of the dipole sensors that is located 1 to 2.7mm away from the probe tip. During measurements, the probe stops shortly above the phantom surface, depending on the probe and the surface detecting system. Both distances are included as parameters in the probe configuration file. The software always knows exactly how far away the measured point is from the surface. As the probe cannot directly measure at the surface, the values between the deepest measured point and the surface must be extrapolated. The angle between the probe axis and the surface normal line is less than 30 degree.

In the Area Scan, the gradient of the interpolation function is evaluated to find all the extreme of the SAR distribution. The uncertainty on the locations of the extreme is less than 1/20 of the grid size. Only local maximum within -2 dB of the global maximum are searched and passed for the Cube Scan measurement. In the Cube Scan, the interpolation function is used to extrapolate the Peak SAR from the lowest measurement points to the inner phantom surface (the extrapolation distance). 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 5mm.

The maximum search is automatically performed after each area scan measurement. It is based on splines in two or three dimensions. The procedure can find the maximum for most SAR distributions even with relatively large grid spacing. After the area scanning measurement, the probe is automatically moved to a position at the interpolated maximum. The following scan can directly use this position for reference, e.g., for a finer resolution grid or the cube evaluations. The 1g and 10g peak evaluations are only available for the predefined cube 7x7x7 scans. The routines are verified and optimized for the grid dimensions used in these cube measurements.

The measured volume of 30x30x30mm contains about 30g of tissue.

The first procedure is an extrapolation (incl. Boundary correction) to get the points between the lowest measured plane and the surface. The next step uses 3D

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interpolation to get all points within the measured volume. In the last step, a 1g cube is placed numerically into the volume and its averaged SAR is calculated. This cube is moved around until the highest averaged SAR is found. If the highest SAR is found at the edge of the measured volume, the system will issue a warning: higher SAR values might be found outside of the measured volume. In that case the cube measurement can be repeated, using the new interpolated maximum as the center.

1.11 Probe Calibration Procedures

For the calibration of E-field probes in lossy liquids, an electric field with an accurately known field strength must be produced within the measured liquid. For standardization purposes it would be desirable if all measurements which are necessary to assess the correct field strength would be traceable to standardized measurement procedures. In the following two different calibration techniques are summarized:

1.11.1 Transfer Calibration with Temperature Probes

In lossy liquids the specific absorption rate (SAR) is related both to the electric field (E) and the temperature gradient ($\delta T / \delta t$) in the liquid.

$$SAR = \frac{\sigma}{\rho} |E|^2 = c \frac{\delta T}{\delta t}$$

whereby σ is the conductivity, ρ the density and c the heat capacity of the liquid.

Hence, the electric field in lossy liquid can be measured indirectly by measuring the temperature gradient in the liquid. Non-disturbing temperature probes (optical probes or thermistor probes with resistive lines) with high spatial resolution (<1-2 mm) and fast reaction time (<1 s) are available and can be easily calibrated with high precision [1]. The setup and the exciting source have no influence on the calibration; only the relative positioning uncertainties of the standard temperature probe and the E-field probe to be calibrated must be considered. However, several problems limit the available accuracy of probe calibrations with temperature probes:

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- The temperature gradient is not directly measurable but must be evaluated from temperature measurements at different time steps. Special precaution is necessary to avoid measurement errors caused by temperature gradients due to energy equalizing effects or convection currents in the liquid. Such effects cannot be completely avoided, as the measured field itself destroys the thermal equilibrium in the liquid. With a careful setup these errors can be kept small.
- The measured volume around the temperature probe is not well defined. It is difficult to calculate the energy transfer from a surrounding gradient temperature field into the probe. These effects must be considered, since temperature probes are calibrated in liquid with homogeneous temperatures. There is no traceable standard for temperature rise measurements.
- The calibration depends on the assessment of the specific density, the heat capacity and the conductivity of the medium. While the specific density and heat capacity can be measured accurately with standardized procedures ($\sim 2\%$ for c ; much better for ρ), there is no standard for the measurement of the conductivity. Depending on the method and liquid, the error can well exceed $\pm 5\%$.
- Temperature rise measurements are not very sensitive and therefore are often performed at a higher power level than the E-field measurements. The nonlinearities in the system (e.g., power measurements, different components, etc.) must be considered.

Considering these problems, the possible accuracy of the calibration of E-field probes with temperature gradient measurements in a carefully designed setup is about $\pm 10\%$ (RSS) [2]. Recently, a setup which is a combination of the waveguide techniques and the thermal measurements was presented in [3]. The estimated uncertainty of the setup is $\pm 5\%$ (RSS) when the same liquid is used for the calibration and for actual measurements and $\pm 7-9\%$ (RSS) when not, which is in good agreement with the estimates given in [2].

1.11.2 Calibration with Analytical Fields

In this method a technical setup is used in which the field can be calculated analytically from measurements of other physical magnitudes (e.g., input power). This corresponds to the standard field method for probe calibration in air; however, there is no standard defined for fields in lossy liquids.

When using calculated fields in lossy liquids for probe calibration, several points must be considered in the assessment of the uncertainty:

- The setup must enable accurate determination of the incident power.
- The accuracy of the calculated field strength will depend on the assessment of the dielectric parameters of the liquid.
- Due to the small wavelength in liquids with high permittivity, even small

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setups might be above the resonant cutoff frequencies. The field distribution in the setup must be carefully checked for conformity with the theoretical field distribution.

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1. N. Kuster, Q. Balzano, and J.C. Lin, Eds., *Mobile Communications Safety*, Chapman & Hall, London, 1997.
2. K. Meier, M. Burkhardt, T. Schmid, and N. Kuster, "Broadband calibration of E-field probes in lossy media", *IEEE Transactions on Microwave Theory and Techniques*, vol. 44, no. 10, pp. 1954-1962, Oct. 1996.
3. K. Jokela, P. Hyysalo, and L. Puranen, "Calibration of specific absorption rate (SAR) probes in waveguide at 900 MHz", *IEEE Transactions on Instrumentation and Measurements*, vol. 47, no. 2, pp. 432-438, Apr. 1998.

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1.12 Test Standards and Limits

According to FCC 47CFR §2.1093(d) The limits to be used for evaluation are based generally on criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate (“SAR”) in Section 4.2 of “IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz,” ANSI/IEEE C95.1, By the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017. These criteria for SAR evaluation are similar to those recommended by the National Council on Radiation Protection and Measurements (NCRP) in “Biological Effects and Exposure Criteria for Radio frequency Electromagnetic Fields,” NCRP Report No. 86, Section 17.4.5. Copyright NCRP, 1986, Bethesda, Maryland 20814. SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards. The criteria to be used are specified in paragraphs (d)(1) and (d)(2) of this section and shall apply for portable devices transmitting in the frequency range from 100 kHz to 6 GHz. Portable devices that transmit at frequencies above 6 GHz are to be evaluated in terms of the MPE limits specified in § 1.1310 of this chapter. Measurements and calculations to demonstrate compliance with MPE field strength or power density limits for devices operating above 6 GHz should be made at a minimum distance of 5 cm from the radiating source.

- (1) Limits for Occupational/Controlled exposure: 0.4 W/kg as averaged over the whole-body and spatial peak SAR not exceeding 8 W/kg as averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the hands, wrists, feet and ankles where the spatial peak SAR shall not exceed 20 W/kg, as averaged over an 10 grams of tissue (defined as a tissue volume in the shape of a cube).
- (2) Occupational/Controlled limits apply when persons are exposed as a consequence of their employment provided these persons are fully aware of and exercise control over their exposure. Awareness of exposure can be accomplished by use of warning labels or by specific training or education through appropriate means, such as an RF safety program in a work environment.
- (3) Limits for General Population/Uncontrolled exposure: 0.08 W/kg as averaged over the whole-body and spatial peak SAR not exceeding 1.6 W/kg as averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the hands, wrists, feet and ankles where the spatial peak SAR shall not exceed 4 W/kg, as averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube). General Population/Uncontrolled limits apply when the general public may be exposed, or when persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or do not

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exercise control over their exposure. Warning labels placed on consumer devices such as cellular telephones will not be sufficient reason to allow these devices to be evaluated subject to limits for occupational/controlled exposure in paragraph (d)(1) of this section. (Table 4.)

Human Exposure	Uncontrolled Environment General Population	Controlled Environment Occupational
Spatial Peak SAR (Brain)	1.60 W/kg	8.00 W/kg
Spatial Average SAR (Whole Body)	0.08 W/kg	0.40 W/kg
Spatial Peak SAR (Hands/Feet/Ankle/Wrist)	4.00 W/kg	20.00 W/kg

Table 4. RF exposure limits

Notes:

1. Uncontrolled environments are defined as locations where there is potential exposure of individuals who have no knowledge or control of their potential exposure.
2. Controlled environments are defined as locations where there is potential exposure of individuals who have knowledge of their potential exposure and can exercise control over their exposure.

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2. Summary of Results

2.1 Decision rules

Reported measurement data comply with IEEE 1528-2013:
Determining compliance shall be based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

2.2 Summary of Results

TX1 WLAN 802.11b

Body

Antenna	Mode	Position	Distance (mm)	CH	Freq. (MHz)	Max. Rated Avg. Power + Max. Tolerance (dBm)	Measured Avg. Power (dBm)	Scaling	Averaged SAR over 1g (W/kg)		Plot page
									Measured	Reported	
Tx1	WLAN 802.11b	3-1	0	6	2437	17	16.82	104.23%	0.009	0.010	52

Extremity

Antenna	Mode	Position	Distance (mm)	CH	Freq. (MHz)	Max. Rated Avg. Power + Max. Tolerance (dBm)	Measured Avg. Power (dBm)	Scaling	Averaged SAR over 10g (W/kg)		Plot page
									Measured	Reported	
Tx1	WLAN 802.11b	2	0	6	2437	17	16.82	104.23%	0.283	0.295	-
		2-2	0	6	2437	17	16.82	104.23%	0.314	0.327	-
		2-3	0	2	2417	17	16.94	101.39%	0.431	0.437	-
		2-3	0	6	2437	17	16.82	104.23%	0.441	0.460	53
		2-3	0	10	2457	17	16.87	103.04%	0.422	0.435	-
		2-4	0	6	2437	17	16.82	104.23%	0.172	0.179	-
		2-5	0	6	2437	17	16.82	104.23%	0.133	0.139	-
		2-6	0	6	2437	17	16.82	104.23%	0.113	0.118	-
		2-7	0	6	2437	17	16.82	104.23%	0.218	0.227	-
		2-8	0	6	2437	17	16.82	104.23%	0.151	0.157	-

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Bluetooth (GFSK)

Body

Antenna	Mode	Position	Distance (mm)	CH	Freq. (MHz)	Max. Rated Avg. Power + Max. Tolerance (dBm)	Measured Avg. Power (dBm)	Scaling	Averaged SAR over 1g (W/kg)		Plot page
									Measured	Reported	
Tx1	Bluetooth(GFSK)	3-1	0	78	2480	5.5	5.49	100.23%	0.004	0.004	54

Extremity

Antenna	Mode	Position	Distance (mm)	CH	Freq. (MHz)	Max. Rated Avg. Power + Max. Tolerance (dBm)	Measured Avg. Power (dBm)	Scaling	Averaged SAR over 10g (W/kg)		Plot page
									Measured	Reported	
Tx1	Bluetooth(GFSK)	2	0	78	2480	5.5	5.49	100.23%	0.007	0.007	-
		2-2	0	78	2480	5.5	5.49	100.23%	0.007	0.007	-
		2-3	0	78	2480	5.5	5.49	100.23%	0.008	0.008	55
		2-4	0	78	2480	5.5	5.49	100.23%	0.006	0.006	-
		2-5	0	78	2480	5.5	5.49	100.23%	0.006	0.006	-
		2-6	0	78	2480	5.5	5.49	100.23%	0.005	0.005	-
		2-7	0	78	2480	5.5	5.49	100.23%	0.006	0.006	-
		2-8	0	78	2480	5.5	5.49	100.23%	0.005	0.005	-

WLAN 802.11a 5.2G

Body

Antenna	Mode	Position	Distance (mm)	CH	Freq. (MHz)	Max. Rated Avg. Power + Max. Tolerance (dBm)	Measured Avg. Power (dBm)	Scaling	Averaged SAR over 1g (W/kg)		Plot page
									Measured	Reported	
Tx1	WLAN 802.11a 5.2G	3-1	0	48	5240	17.5	17.5	100.00%	0.053	0.053	56

Extremity

Antenna	Mode	Position	Distance (mm)	CH	Freq. (MHz)	Max. Rated Avg. Power + Max. Tolerance (dBm)	Measured Avg. Power (dBm)	Scaling	Averaged SAR over 10g (W/kg)		Plot page
									Measured	Reported	
Tx1	WLAN 802.11a 5.2G	2	0	48	5240	17.5	17.5	100.00%	0.576	0.576	-
		2-2	0	48	5240	17.5	17.5	100.00%	0.606	0.606	-
		2-3	0	48	5240	17.5	17.5	100.00%	0.856	0.856	57
		2-4	0	48	5240	17.5	17.5	100.00%	0.331	0.331	-
		2-5	0	48	5240	17.5	17.5	100.00%	0.287	0.287	-
		2-6	0	48	5240	17.5	17.5	100.00%	0.265	0.265	-
		2-7	0	48	5240	17.5	17.5	100.00%	0.364	0.364	-
		2-8	0	48	5240	17.5	17.5	100.00%	0.318	0.318	-

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WLAN 802.11a 5.3G

Body

Antenna	Mode	Position	Distance (mm)	CH	Freq. (MHz)	Max. Rated Avg. Power + Max. Tolerance (dBm)	Measured Avg. Power (dBm)	Scaling	Averaged SAR over 1g (W/kg)		Plot page
									Measured	Reported	
Tx1	WLAN 802.11a 5.3G	3-1	0	56	5280	17.5	17.49	100.23%	0.041	0.041	58

Extremity

58+A7:M8	Mode	Position	Distance (mm)	CH	Freq. (MHz)	Max. Rated Avg. Power + Max. Tolerance (dBm)	Measured Avg. Power (dBm)	Scaling	Averaged SAR over 10g (W/kg)		Plot page
									Measured	Reported	
Tx1	WLAN 802.11a 5.3G	2	0	56	5280	17.5	17.49	100.23%	0.563	0.564	-
		2-2	0	56	5280	17.5	17.49	100.23%	0.582	0.583	-
		2-3	0	56	5280	17.5	17.49	100.23%	0.718	0.720	59
		2-4	0	56	5280	17.5	17.49	100.23%	0.317	0.318	-
		2-5	0	56	5280	17.5	17.49	100.23%	0.268	0.269	-
		2-6	0	56	5280	17.5	17.49	100.23%	0.251	0.252	-
		2-7	0	56	5280	17.5	17.49	100.23%	0.322	0.323	-
		2-8	0	56	5280	17.5	17.49	100.23%	0.298	0.299	-

WLAN 802.11a 5.6G

Body

Antenna	Mode	Position	Distance (mm)	CH	Freq. (MHz)	Max. Rated Avg. Power + Max. Tolerance (dBm)	Measured Avg. Power (dBm)	Scaling	Averaged SAR over 1g (W/kg)		Plot page
									Measured	Reported	
Tx1	WLAN 802.11a 5.6G	3-1	0	136	5680	17.5	17.5	100.00%	0.056	0.056	60

Extremity

Antenna	Mode	Position	Distance (mm)	CH	Freq. (MHz)	Max. Rated Avg. Power + Max. Tolerance (dBm)	Measured Avg. Power (dBm)	Scaling	Averaged SAR over 10g (W/kg)		Plot page
									Measured	Reported	
Tx1	WLAN 802.11a 5.6G	2	0	136	5680	17.5	17.5	100.00%	0.812	0.812	-
		2-2	0	136	5680	17.5	17.5	100.00%	0.884	0.884	-
		2-3	0	104	5520	17.5	17.5	100.00%	0.572	0.572	-
		2-3	0	116	5580	17.5	17.49	100.23%	0.799	0.801	-
		2-3	0	120	5600	17.5	17.48	100.46%	0.818	0.822	-
		2-3	0	136	5680	17.5	17.5	100.00%	1.190	1.190	61
		2-4	0	136	5680	17.5	17.5	100.00%	0.388	0.388	-
		2-5	0	136	5680	17.5	17.5	100.00%	0.357	0.357	-
		2-6	0	136	5680	17.5	17.5	100.00%	0.355	0.355	-
		2-7	0	136	5680	17.5	17.5	100.00%	0.408	0.408	-
2-8	0	136	5680	17.5	17.5	100.00%	0.364	0.364	-		

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WLAN 802.11a 5.8G

Body

Antenna	Mode	Position	Distance (mm)	CH	Freq. (MHz)	Max. Rated Avg. Power + Max. Tolerance (dBm)	Measured Avg. Power (dBm)	Scaling	Averaged SAR over 1g (W/kg)		Plot page
									Measured	Reported	
Tx1	WLAN 802.11a 5.8G	3-1	0	149	5745	17.5	17.5	100.00%	0.062	0.062	62

Extremity

Antenna	Mode	Position	Distance (mm)	CH	Freq. (MHz)	Max. Rated Avg. Power + Max. Tolerance (dBm)	Measured Avg. Power (dBm)	Scaling	Averaged SAR over 10g (W/kg)		Plot page
									Measured	Reported	
Tx1	WLAN 802.11a 5.8G	2	0	149	5745	17.5	17.5	100.00%	0.784	0.784	-
		2-2	0	149	5745	17.5	17.5	100.00%	0.832	0.832	-
		2-3	0	149	5745	17.5	17.5	100.00%	1.180	1.180	63
		2-4	0	149	5745	17.5	17.5	100.00%	0.385	0.385	-
		2-5	0	149	5745	17.5	17.5	100.00%	0.358	0.358	-
		2-6	0	149	5745	17.5	17.5	100.00%	0.351	0.351	-
		2-7	0	149	5745	17.5	17.5	100.00%	0.399	0.399	-
		2-8	0	149	5745	17.5	17.5	100.00%	0.356	0.356	-

TX2 WLAN 802.11b

Body

Antenna	Mode	Position	Distance (mm)	CH	Freq. (MHz)	Max. Rated Avg. Power + Max. Tolerance (dBm)	Measured Avg. Power (dBm)	Scaling	Averaged SAR over 1g (W/kg)		Plot page
									Measured	Reported	
Tx2	WLAN 802.11b	3-1	0	6	2437	17	16.91	102.09%	0.023	0.024	64

Extremity

Antenna	Mode	Position	Distance (mm)	CH	Freq. (MHz)	Max. Rated Avg. Power + Max. Tolerance (dBm)	Measured Avg. Power (dBm)	Scaling	Averaged SAR over 10g (W/kg)		Plot page
									Measured	Reported	
Tx2	WLAN 802.11b	1	0	2	2417	17	16.86	103.28%	0.683	0.705	-
		1	0	6	2437	17	16.91	102.09%	0.694	0.709	65
		1	0	10	2457	17	16.91	102.09%	0.677	0.691	-
		1-2	0	6	2437	17	16.91	102.09%	0.573	0.585	-
		1-4	0	6	2437	17	16.91	102.09%	0.241	0.246	-
		2-4	0	6	2437	17	16.91	102.09%	0.337	0.344	-
		2-5	0	6	2437	17	16.91	102.09%	0.223	0.228	-
		2-6	0	6	2437	17	16.91	102.09%	0.192	0.196	-

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WLAN 802.11a 5.2G

Body

Antenna	Mode	Position	Distance (mm)	CH	Freq. (MHz)	Max. Rated Avg. Power + Max. Tolerance (dBm)	Measured Avg. Power (dBm)	Scaling	Averaged SAR over 1g (W/kg)		Plot page
									Measured	Reported	
Tx2	WLAN 802.11a 5.2G	3-1	0	48	5240	17.5	17.5	100.00%	0.123	0.123	66

Extremity

Antenna	Mode	Position	Distance (mm)	CH	Freq. (MHz)	Max. Rated Avg. Power + Max. Tolerance (dBm)	Measured Avg. Power (dBm)	Scaling	Averaged SAR over 10g (W/kg)		Plot page
									Measured	Reported	
Tx2	WLAN 802.11a 5.2G	1	0	48	5240	17.5	17.5	100.00%	0.731	0.731	67
		1-2	0	48	5240	17.5	17.5	100.00%	0.598	0.598	-
		1-4	0	48	5240	17.5	17.5	100.00%	0.253	0.253	-
		2-4	0	48	5240	17.5	17.5	100.00%	0.352	0.352	-
		2-5	0	48	5240	17.5	17.5	100.00%	0.236	0.236	-
		2-6	0	48	5240	17.5	17.5	100.00%	0.211	0.211	-

WLAN 802.11a 5.3G

Body

Antenna	Mode	Position	Distance (mm)	CH	Freq. (MHz)	Max. Rated Avg. Power + Max. Tolerance (dBm)	Measured Avg. Power (dBm)	Scaling	Averaged SAR over 1g (W/kg)		Plot page
									Measured	Reported	
Tx2	WLAN 802.11a 5.3G	3-1	0	56	5280	17.5	17.49	100.23%	0.138	0.138	68

Extremity

Antenna	Mode	Position	Distance (mm)	CH	Freq. (MHz)	Max. Rated Avg. Power + Max. Tolerance (dBm)	Measured Avg. Power (dBm)	Scaling	Averaged SAR over 10g (W/kg)		Plot page
									Measured	Reported	
Tx2	WLAN 802.11a 5.3G	1	0	52	5260	17.5	17.48	100.46%	0.781	0.785	69
		1	0	56	5280	17.5	17.49	100.23%	0.760	0.762	-
		1	0	60	5300	17.5	17.46	100.93%	0.756	0.763	-
		1-2	0	56	5280	17.5	17.49	100.23%	0.611	0.612	-
		1-4	0	56	5280	17.5	17.49	100.23%	0.261	0.262	-
		2-4	0	56	5280	17.5	17.49	100.23%	0.359	0.360	-
		2-5	0	56	5280	17.5	17.49	100.23%	0.242	0.243	-
		2-6	0	56	5280	17.5	17.49	100.23%	0.237	0.238	-

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WLAN 802.11a 5.6G

Body

Antenna	Mode	Position	Distance (mm)	CH	Freq. (MHz)	Max. Rated Avg. Power + Max. Tolerance (dBm)	Measured Avg. Power (dBm)	Scaling	Averaged SAR over 1g (W/kg)		Plot page
									Measured	Reported	
Tx2	WLAN 802.11a 5.6G	3-1	0	116	5580	17.5	17.49	100.23%	0.059	0.059	70

Extremity

Antenna	Mode	Position	Distance (mm)	CH	Freq. (MHz)	Max. Rated Avg. Power + Max. Tolerance (dBm)	Measured Avg. Power (dBm)	Scaling	Averaged SAR over 10g (W/kg)		Plot page
									Measured	Reported	
Tx2	WLAN 802.11a 5.6G	1	0	116	5580	17.5	17.49	100.23%	0.640	0.641	71
		1-2	0	116	5580	17.5	17.49	100.23%	0.544	0.545	-
		1-4	0	116	5580	17.5	17.49	100.23%	0.233	0.234	-
		2-4	0	116	5580	17.5	17.49	100.23%	0.327	0.328	-
		2-5	0	116	5580	17.5	17.49	100.23%	0.218	0.219	-
		2-6	0	116	5580	17.5	17.49	100.23%	0.183	0.183	-

WLAN 802.11a 5.8G

Body

Antenna	Mode	Position	Distance (mm)	CH	Freq. (MHz)	Max. Rated Avg. Power + Max. Tolerance (dBm)	Measured Avg. Power (dBm)	Scaling	Averaged SAR over 1g (W/kg)		Plot page
									Measured	Reported	
Tx2	WLAN 802.11a 5.8G	3-1	0	165	5825	17.5	17.5	100.00%	0.065	0.065	72

Extremity

Antenna	Mode	Position	Distance (mm)	CH	Freq. (MHz)	Max. Rated Avg. Power + Max. Tolerance (dBm)	Measured Avg. Power (dBm)	Scaling	Averaged SAR over 10g (W/kg)		Plot page
									Measured	Reported	
Tx2	WLAN 802.11a 5.8G	1	0	165	5825	17.5	17.5	100.00%	0.638	0.638	73
		1-2	0	165	5825	17.5	17.5	100.00%	0.538	0.538	-
		1-4	0	165	5825	17.5	17.5	100.00%	0.227	0.227	-
		2-4	0	165	5825	17.5	17.5	100.00%	0.320	0.320	-
		2-5	0	165	5825	17.5	17.5	100.00%	0.211	0.211	-
		2-6	0	165	5825	17.5	17.5	100.00%	0.176	0.176	-

Note:

$$\text{Scaling} = \frac{\text{reported SAR}}{\text{measured SAR}} = \frac{P2(\text{mW})}{P1(\text{mW})} = 10^{\left(\frac{P2-P1}{10}\right)}(\text{dBm})$$

Reported SAR = measured SAR * (scaling)

Where P2 is maximum specified power, P1 is measured conducted power

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2.3 Reporting statements of conformity

The conformity statement in this report is based solely on the test results, measurement uncertainty is excluded.

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3. Simultaneous Transmission Analysis

Simultaneous Transmission Scenarios:

NO.	Simultaneous Transmit Configurations	Body	Extremity
1	2.4GHz WLAN MIMO	YES	YES
2	5GHz WLAN MIMO	YES	YES
3	Bluetooth + 2.4GHz WLAN Tx2	YES	YES
4	Bluetooth + 5GHz WLAN Tx2	YES	YES

Note :

- 1) Bluetooth and WLAN Tx1 share the same antenna path, and BT can transmit with WLAN Tx2 simultaneously.
- 2) For 2.4G/5GHz WLAN Tx1 and Tx2 antennas, the maximum output power of each antenna during simultaneous transmission is same with that used in standalone transmission, and we used the sum of 1-g/10-g SAR provision in KDB447498D01 to exclude the simultaneous transmitted SAR measurement.

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3.1 Estimated SAR calculation

According to KDB447498 D01v06 – When standalone SAR test exclusion applies to an antenna that transmits simultaneously with other antennas, the standalone SAR must be estimated according to following to determine simultaneous transmission SAR test exclusion:

$$\text{Estimated Body SAR} = \frac{\text{Max. tune up power (mW)}}{\text{Min. test separation distance(mm)}} \times \frac{\sqrt{f(\text{GHz})}}{7.5}$$

$$\text{Estimated Extremity SAR} = \frac{\text{Max. tune up power (mW)}}{\text{Min. test separation distance(mm)}} \times \frac{\sqrt{f(\text{GHz})}}{18.75}$$

If the minimum test separation distance is < 5mm, a distance of 5mm is used for estimated SAR calculation. When the test separation distance is >50mm, the 0.4W/kg is used for SAR-1g(Body), and the 1.0W/kg is used for SAR-10g(Extremity).

Mode / Band	Test position	Antenna to user separation distance	Estimated Extremity SAR (W/kg)
WLAN Tx2 2.4 / 5G	2	>50mm	1.00
WLAN Tx2 2.4 / 5G	2-2	>50mm	1.00
WLAN Tx2 2.4 / 5G	2-3	>50mm	1.00
WLAN Tx2 2.4 / 5G	2-7	>50mm	1.00
WLAN Tx2 2.4 / 5G	2-8	>50mm	1.00
WLAN Tx1 2.4 / 5G	1	>50mm	1.00
WLAN Tx1 2.4 / 5G	1-2	>50mm	1.00
WLAN Tx1 2.4 / 5G	1-4	>50mm	1.00
Bluetooth	1	>50mm	1.00
Bluetooth	1-2	>50mm	1.00
Bluetooth	1-4	>50mm	1.00

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Test Position	Simultaneous Transmission Scenario (Extremity)					Σ SAR 10g (W/kg)
	2.4GHz		5GHz		Bluetooth	
	Tx1	Tx2	Tx1	Tx2		
1	1.000	0.709	-	-	-	1.71
	-	-	1.000	0.785	-	1.79
	-	0.709	-	-	1.000	1.71
	-	-	-	0.785	1.000	1.79
1-2	1.000	0.585	-	-	-	1.59
	-	-	1.000	0.612	-	1.61
	-	0.585	-	-	1.000	1.59
	-	-	-	0.612	1.000	1.61
1-4	1.000	0.246	-	-	-	1.25
	-	-	1.000	0.262	-	1.26
	-	0.246	-	-	1.000	1.25
	-	-	-	0.262	1.000	1.26
2	0.295	1.000	-	-	-	1.30
	-	-	0.812	1.000	-	1.81
	-	1.000	-	-	0.007	1.01
	-	-	-	1.000	0.007	1.01
2-2	0.327	1.000	-	-	-	1.33
	-	-	0.884	1.000	-	1.88
	-	1.000	-	-	0.007	1.01
	-	-	-	1.000	0.007	1.01
2-3	0.460	1.000	-	-	-	1.46
	-	-	1.190	1.000	-	2.19
	-	1.000	-	-	0.008	1.01
	-	-	-	1.000	0.008	1.01
2-4	0.179	0.344	-	-	-	0.52
	-	-	0.388	0.360	-	0.75
	-	0.344	-	-	0.006	0.35
	-	-	-	0.360	0.006	0.37
2-5	0.139	0.228	-	-	-	0.37
	-	-	0.358	0.243	-	0.60
	-	0.228	-	-	0.006	0.23
	-	-	-	0.243	0.006	0.25
2-6	0.118	0.196	-	-	-	0.31
	-	-	0.355	0.238	-	0.59
	-	0.196	-	-	0.005	0.20
	-	-	-	0.238	0.005	0.24
2-7	0.227	1.000	-	-	-	1.23
	-	-	0.408	1.000	-	1.41
	-	1.000	-	-	0.006	1.01
	-	-	-	1.000	0.006	1.01
2-8	0.157	1.000	-	-	-	1.16
	-	-	0.364	1.000	-	1.36
	-	1.000	-	-	0.005	1.01
	-	-	-	1.000	0.005	1.01

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Test Position	Simultaneous Transmission Scenario (Body)					Σ SAR 1g (W/kg)
	2.4GHz		5GHz		Bluetooth	
	Tx1	Tx2	Tx1	Tx2		
3-1	0.010	0.024	-	-	-	0.03
	-	-	0.062	0.138	-	0.20
	-	0.024	-	-	0.004	0.03
	-	-	-	0.138	0.004	0.14

Conclusion:

Body SAR sum is less than 1.6 W/kg, and Extremity SAR sum is less than 4 W/kg, so the simultaneous transmission SAR evaluation is not required.

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4. Instruments List

Manufacturer	Device	Type	Serial number	Date of last calibration	Date of next calibration
SPEAG	Dosimetric E-Field Probe	EX3DV4	3938	Oct.24,2018	Oct.23,2019
SPEAG	System Validation Dipole	D2450V2	727	Apr.24,2018	Apr.23,2019
		D5GHzV2	1040	Jun.28,2018	Jun.27,2019
SPEAG	Data acquisition Electronics	DAE4	1260	Nov.30,2018	Nov.29,2019
SPEAG	Software	DASY 52 V52.10.2	N/A	Calibration not required	Calibration not required
SPEAG	Phantom	ELI	N/A	Calibration not required	Calibration not required
Agilent	Network Analyzer	E5071C	MY46107530	Feb.23,2019	Feb.22,2020
Agilent	Dielectric Probe Kit	85070E	MY44300677	Calibration not required	Calibration not required
Agilent	Dual-directional coupler	772D	MY52180142	Jul.04,2018	Jul.03,2019
Agilent	MXG Analog Signal Generator	N5181A	MY50141235	Apr.09,2018	Apr.08,2019
Agilent	Power Meter	ML2496A	1326001	Aug.09,2018	Aug.02,2019
Agilent	Power Sensor	MA2411B	1315048	Aug.09,2018	Aug.02,2019
			1315049	Aug.09,2018	Aug.02,2019
TECPEL	Digital thermometer	DTM-303A	TP131515	Jul.17,2018	Jul.16,2019

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5. Measurements

Date: 2019/3/20

WLAN802.11b_Body_3-1_CH 1_Tx1_0mm

Communication System: WLAN 2.45G; Frequency: 2412 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 2412$ MHz; $\sigma = 1.965$ S/m; $\epsilon_r = 51.188$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Ambient temperature: 21.7°C; Liquid temperature: 21.9°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3938;ConvF(7.3, 7.3, 7.3);Calibrated: 2018/10/24
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1260; Calibrated: 2018/11/30
- Phantom: ELI
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Area Scan (71x101x1): Interpolated grid: dx=12 mm, dy=12 mm
Maximum value of SAR (interpolated) = 0.0143 W/kg

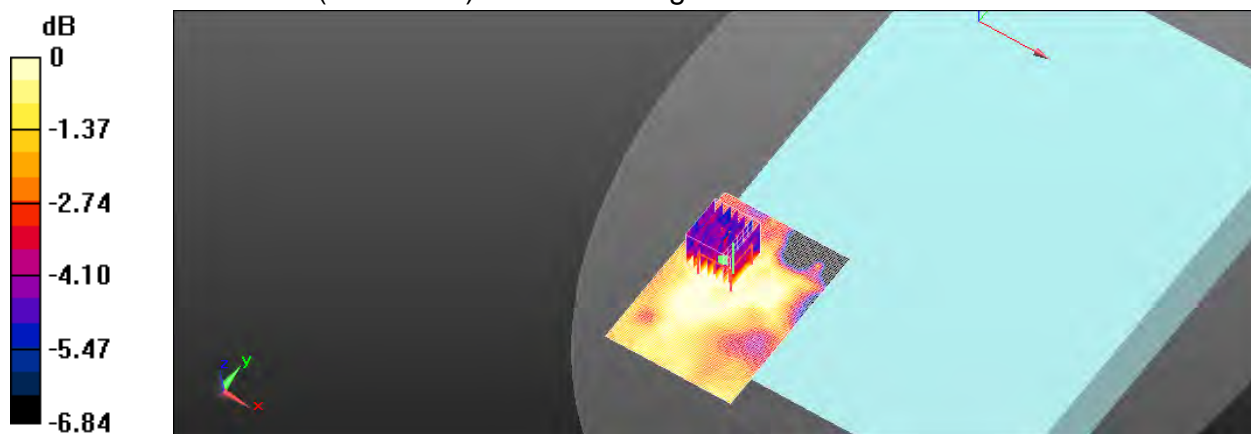
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 2.671 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 0.0140 W/kg

SAR(1 g) = 0.00913 W/kg; SAR(10 g) = 0.00632 W/kg

Maximum value of SAR (measured) = 0.0118 W/kg



0 dB = 0.0118 W/kg = -19.28 dBW/kg

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Date: 2019/3/20

WLAN 802.11b_Extremity_2-3_CH 6_Tx1_0mm

Communication System: WLAN 2.45G; Frequency: 2437 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 2437$ MHz; $\sigma = 2.004$ S/m; $\epsilon_r = 51.014$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Ambient temperature: 21.7°C; Liquid temperature: 21.9°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3938; ConvF(7.3, 7.3, 7.3); Calibrated: 2018/10/24
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1260; Calibrated: 2018/11/30
- Phantom: ELI
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Area Scan (81x81x1): Interpolated grid: dx=12 mm, dy=12 mm

Maximum value of SAR (interpolated) = 2.11 W/kg

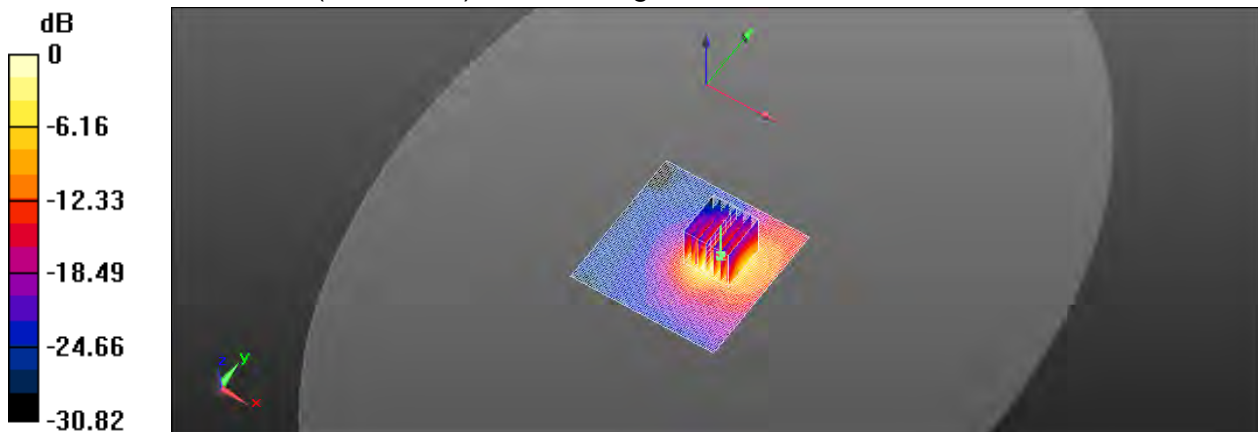
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 2.287 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 3.04 W/kg

SAR(1 g) = 1.17 W/kg; SAR(10 g) = 0.441 W/kg

Maximum value of SAR (measured) = 2.05 W/kg



0 dB = 2.05 W/kg = 3.12 dBW/kg

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Date: 2019/3/20

Bluetooth(GFSK)_Body_3-1_CH 78_Tx1_0mm

Communication System: Bluetooth; Frequency: 2480 MHz

Medium parameters used: $f = 2480$ MHz; $\sigma = 2.06$ S/m; $\epsilon_r = 50.885$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Ambient temperature: 21.7°C; Liquid temperature: 21.9°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3938;ConvF(7.3, 7.3, 7.3);Calibrated: 2018/10/24
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1260; Calibrated: 2018/11/30
- Phantom: ELI
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Area Scan (81x121x1): Interpolated grid: dx=12 mm, dy=12 mm

Maximum value of SAR (interpolated) = 0.00930 W/kg

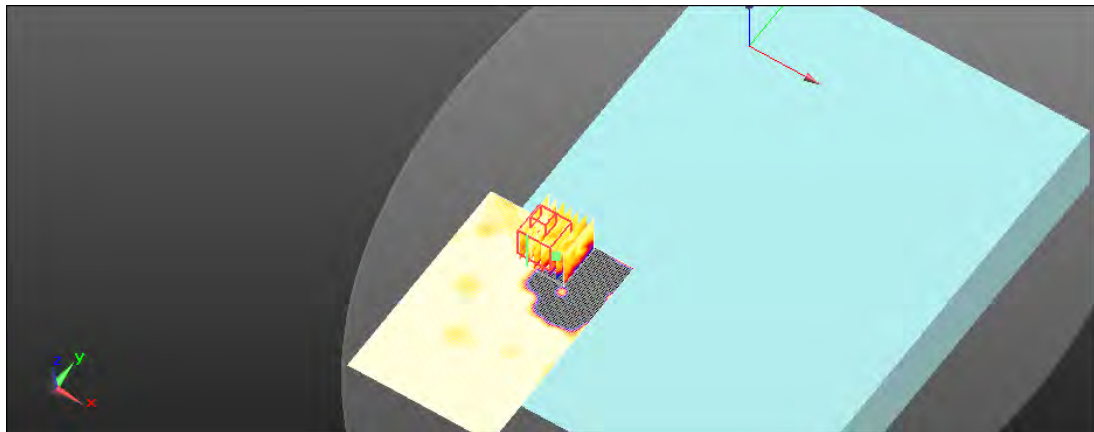
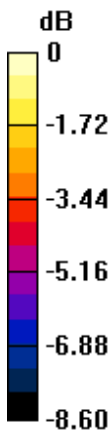
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 2.723 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 0.00514 W/kg

SAR(1 g) = 0.0041 W/kg; SAR(10 g) = 0.00358 W/kg

Maximum value of SAR (measured) = 0.00514 W/kg



0 dB = 0.00514 W/kg = -22.89 dBW/kg

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Date: 2019/3/20

Bluetooth(GFSK)_Extremity_2-3_CH 78_Tx1_0mm

Communication System: Bluetooth; Frequency: 2480 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 2480$ MHz; $\sigma = 2.06$ S/m; $\epsilon_r = 50.885$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Ambient temperature: 21.7°C; Liquid temperature: 21.9°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3938; ConvF(7.3, 7.3, 7.3); Calibrated: 2018/10/24
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1260; Calibrated: 2018/11/30
- Phantom: ELI
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Area Scan (81x81x1): Interpolated grid: dx=12 mm, dy=12 mm

Maximum value of SAR (interpolated) = 0.0176 W/kg

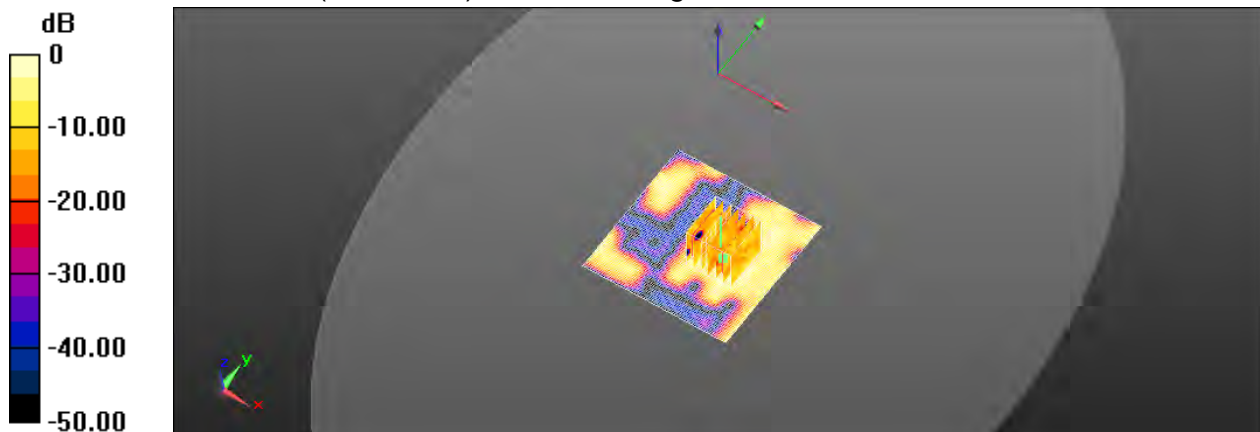
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 2.865 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 0.0400 W/kg

SAR(1 g) = 0.00828 W/kg; SAR(10 g) = 0.00202 W/kg

Maximum value of SAR (measured) = 0.0185 W/kg



0 dB = 0.0185 W/kg = -17.33 dBW/kg

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Date: 2019/3/21

WLAN802.11a 5.2G_Body_3-1_CH 48_Tx1_0mm

Communication System: WLAN 5G; Frequency: 5240 MHz

Medium parameters used: $f = 5240$ MHz; $\sigma = 5.231$ S/m; $\epsilon_r = 48.989$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Ambient temperature: 21.9°C; Liquid temperature: 22.2°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3938;ConvF(4.23, 4.23, 4.23);Calibrated: 2018/10/24
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1260; Calibrated: 2018/11/30
- Phantom: ELI
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Area Scan (81x121x1): Interpolated grid: dx=10 mm, dy=10 mm

Maximum value of SAR (interpolated) = 0.0838 W/kg

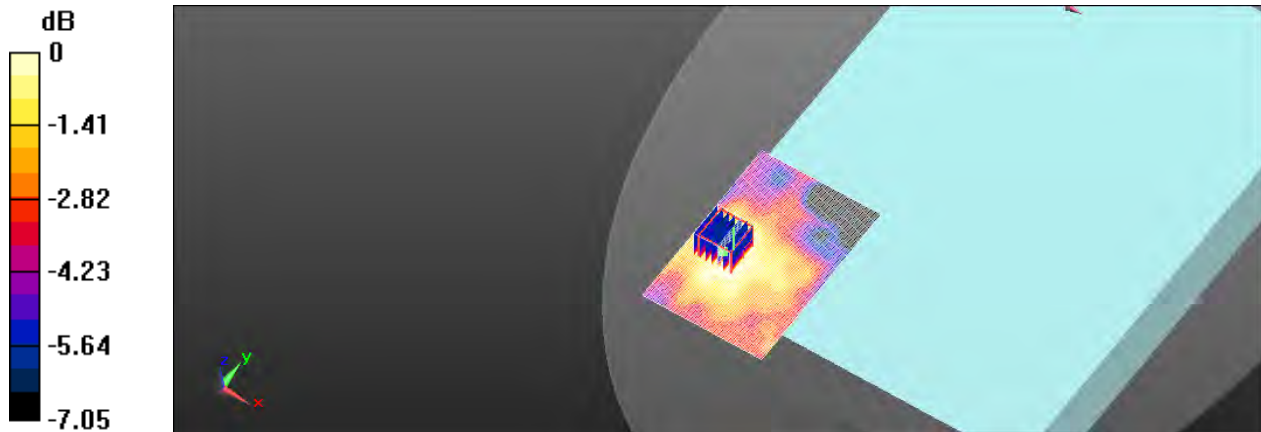
Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 2.294 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 0.204 W/kg

SAR(1 g) = 0.053 W/kg; SAR(10 g) = 0.035 W/kg

Maximum value of SAR (measured) = 0.0790 W/kg



0 dB = 0.0790 W/kg = -11.02 dBW/kg

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Date: 2019/3/21

WLAN802.11a(20M) 5.2G_Extremity_2-3_CH 48_Tx1_0mm

Communication System: WLAN 5G; Frequency: 5240 MHz

Medium parameters used: $f = 5240$ MHz; $\sigma = 5.231$ S/m; $\epsilon_r = 48.989$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Ambient temperature: 21.9°C; Liquid temperature: 22.2°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3938;ConvF(4.23, 4.23, 4.23);Calibrated: 2018/10/24
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1260; Calibrated: 2018/11/30
- Phantom: ELI
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Area Scan (61x91x1): Interpolated grid: dx=10 mm, dy=10 mm

Maximum value of SAR (interpolated) = 5.57 W/kg

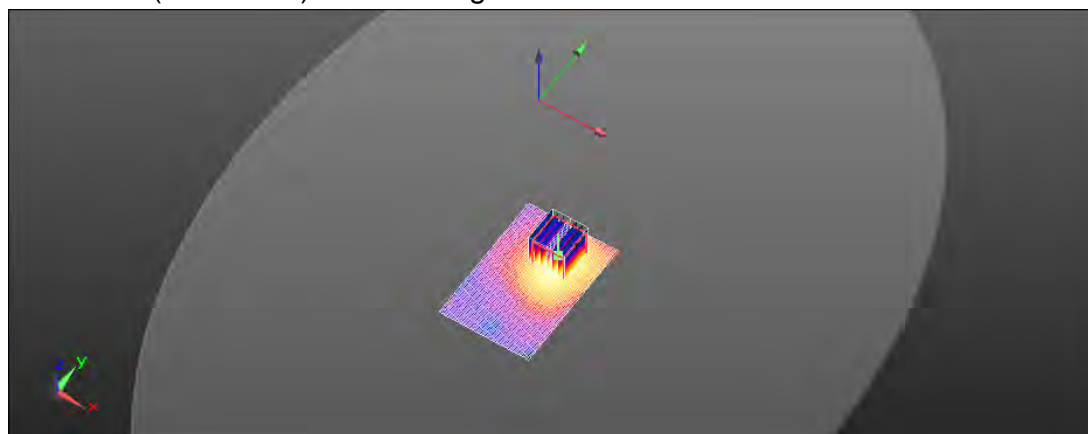
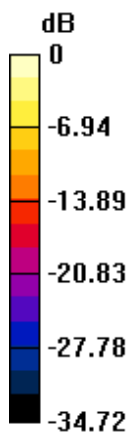
Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 2.941 V/m; Power Drift = -0.11 dB

Peak SAR (extrapolated) = 13.0 W/kg

SAR(1 g) = 2.97 W/kg; SAR(10 g) = 0.856 W/kg

Maximum value of SAR (measured) = 6.42 W/kg



0 dB = 6.42 W/kg = 8.08 dBW/kg

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Date: 2019/3/22

WLAN802.11a 5.3G_Body_3-1_CH 56_Tx1_0mm

Communication System: WLAN 5G; Frequency: 5280 MHz

Medium parameters used: $f = 5280$ MHz; $\sigma = 5.305$ S/m; $\epsilon_r = 48.863$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Ambient temperature: 21.8°C; Liquid temperature: 22.2°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3938;ConvF(4.23, 4.23, 4.23);Calibrated: 2018/10/24
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1260; Calibrated: 2018/11/30
- Phantom: ELI
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Area Scan (81x121x1): Interpolated grid: dx=10 mm, dy=10 mm

Maximum value of SAR (interpolated) = 0.0722 W/kg

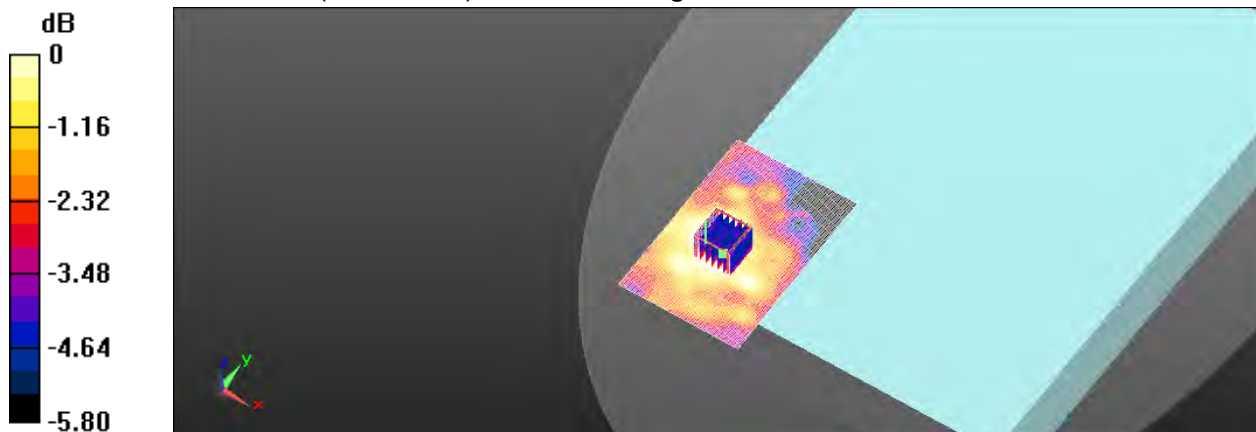
Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 2.318 V/m; Power Drift = 0.11 dB

Peak SAR (extrapolated) = 0.163 W/kg

SAR(1 g) = 0.041 W/kg; SAR(10 g) = 0.029 W/kg

Maximum value of SAR (measured) = 0.0583 W/kg



0 dB = 0.0583 W/kg = -12.34 dBW/kg

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Date: 2019/3/22

WLAN802.11a 5.3G Extremity 2-3_CH 56_Tx1_0mm

Communication System: WLAN 5G; Frequency: 5280 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 5280$ MHz; $\sigma = 5.305$ S/m; $\epsilon_r = 48.863$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Ambient temperature: 21.8°C; Liquid temperature: 22.2°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3938;ConvF(4.23, 4.23, 4.23);Calibrated: 2018/10/24
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1260; Calibrated: 2018/11/30
- Phantom: ELI
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Area Scan (61x91x1): Interpolated grid: dx=10 mm, dy=10 mm

Maximum value of SAR (interpolated) = 4.30 W/kg

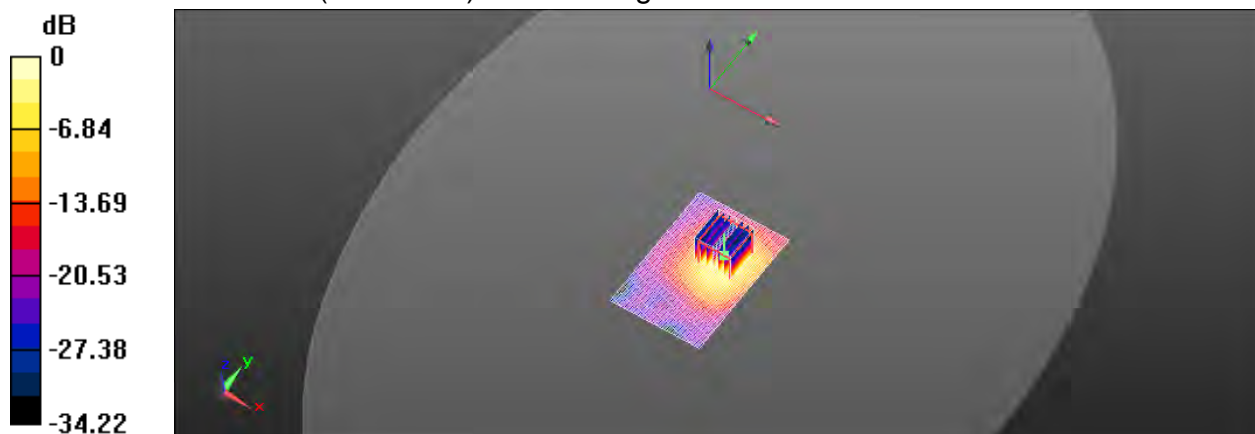
Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 2.238 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 10.9 W/kg

SAR(1 g) = 2.44 W/kg; SAR(10 g) = 0.718 W/kg

Maximum value of SAR (measured) = 5.27 W/kg



0 dB = 5.27 W/kg = 7.22 dBW/kg

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Date: 2019/3/23

WLAN802.11a 5.6G_Body_3-1_CH 136_Tx1_0mm

Communication System: WLAN 5G; Frequency: 5680 MHz

Medium parameters used: $f = 5680$ MHz; $\sigma = 5.963$ S/m; $\epsilon_r = 47.631$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Ambient temperature: 22.0°C; Liquid temperature: 21.7°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3938;ConvF(4, 4, 4);Calibrated: 2018/10/24
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1260; Calibrated: 2018/11/30
- Phantom: ELI
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Area Scan (81x121x1): Interpolated grid: dx=10 mm, dy=10 mm

Maximum value of SAR (interpolated) = 0.0938 W/kg

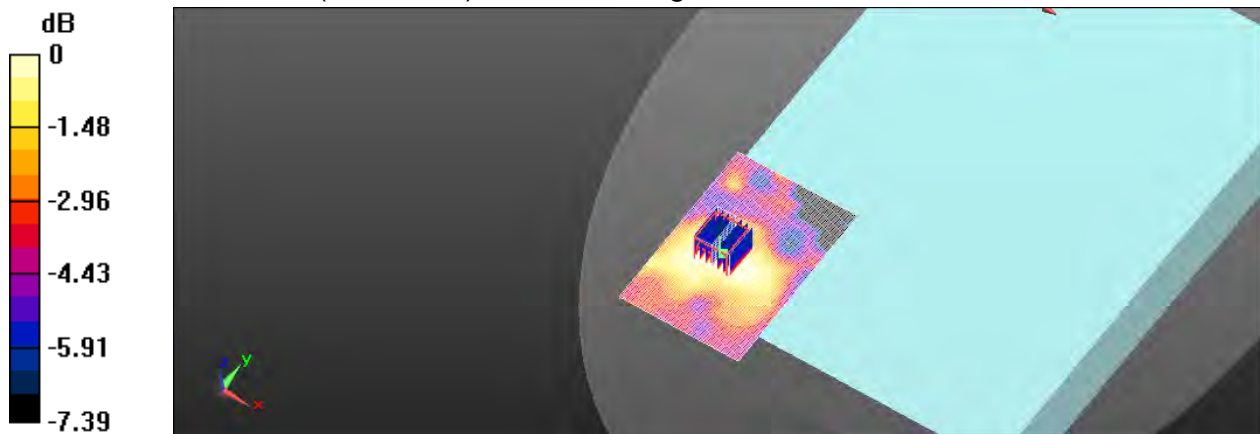
Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 2.888 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 0.224 W/kg

SAR(1 g) = 0.056 W/kg; SAR(10 g) = 0.037 W/kg

Maximum value of SAR (measured) = 0.0900 W/kg



0 dB = 0.0900 W/kg = -10.46 dBW/kg

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Date: 2019/3/23

WLAN802.11a 5.6G Extremity 2-3_CH 136_Tx1_0mm

Communication System: WLAN 5G; Frequency: 5680 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 5680$ MHz; $\sigma = 5.963$ S/m; $\epsilon_r = 47.631$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Ambient temperature: 22.0°C; Liquid temperature: 21.7°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3938; ConvF(4, 4, 4); Calibrated: 2018/10/24
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1260; Calibrated: 2018/11/30
- Phantom: ELI
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Area Scan (61x91x1): Interpolated grid: dx=10 mm, dy=10 mm

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

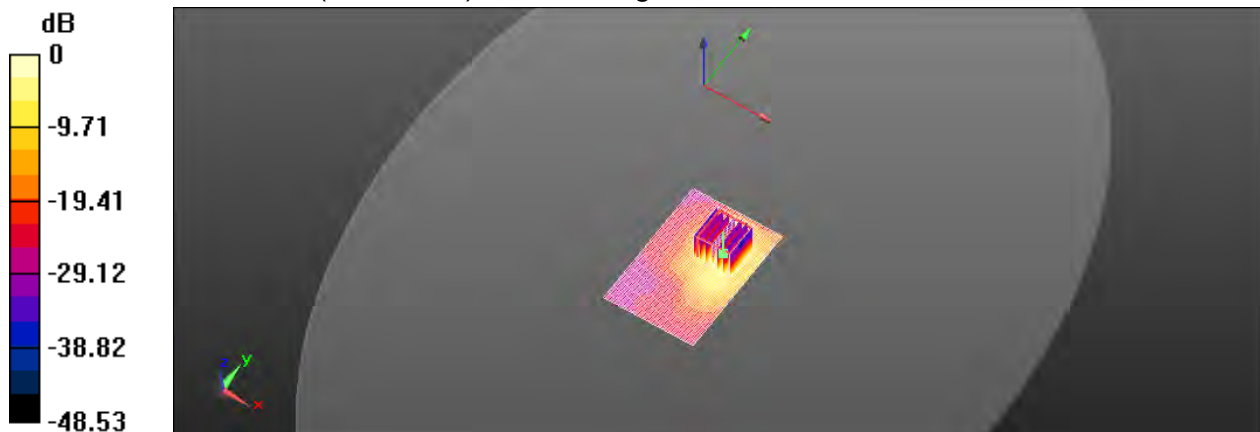
Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 2.314 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 25.0 W/kg

SAR(1 g) = 4.82 W/kg; SAR(10 g) = 1.19 W/kg

Maximum value of SAR (measured) = 11.0 W/kg



0 dB = 11.0 W/kg = 10.41 dBW/kg

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Date: 2019/3/24

WLAN802.11a 5.8G_Body_3-1_CH 149_Tx1_0mm

Communication System: WLAN 5G; Frequency: 5745 MHz

Medium parameters used: $f = 5745$ MHz; $\sigma = 6.062$ S/m; $\epsilon_r = 47.428$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Ambient temperature: 22.2°C; Liquid temperature: 21.9°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3938;ConvF(4, 4, 4);Calibrated: 2018/10/24
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1260; Calibrated: 2018/11/30
- Phantom: ELI
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Area Scan (81x121x1): Interpolated grid: dx=10 mm, dy=10 mm

Maximum value of SAR (interpolated) = 0.122 W/kg

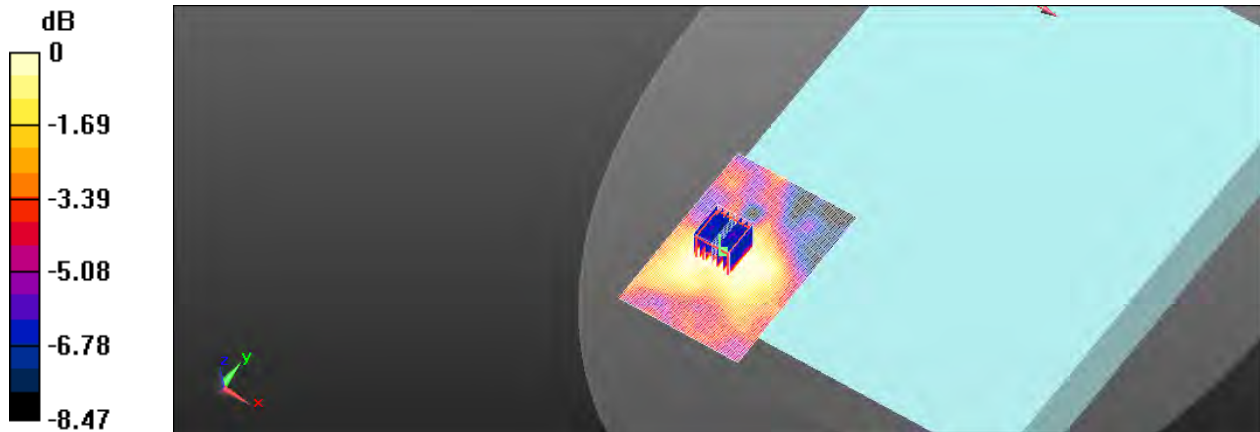
Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 2.214 V/m; Power Drift = 0.11 dB

Peak SAR (extrapolated) = 0.174 W/kg

SAR(1 g) = 0.062 W/kg; SAR(10 g) = 0.039 W/kg

Maximum value of SAR (measured) = 0.104 W/kg



0 dB = 0.104 W/kg = -9.83 dBW/kg

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Date: 2019/3/24

WLAN802.11a 5.8G Extremity 2-3_CH 149_Tx1_0mm

Communication System: WLAN 5G; Frequency: 5745 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 5745$ MHz; $\sigma = 6.062$ S/m; $\epsilon_r = 47.428$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Ambient temperature: 22.2°C; Liquid temperature: 21.9°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3938;ConvF(4, 4, 4);Calibrated: 2018/10/24
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1260; Calibrated: 2018/11/30
- Phantom: ELI
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Area Scan (61x91x1): Interpolated grid: dx=10 mm, dy=10 mm

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

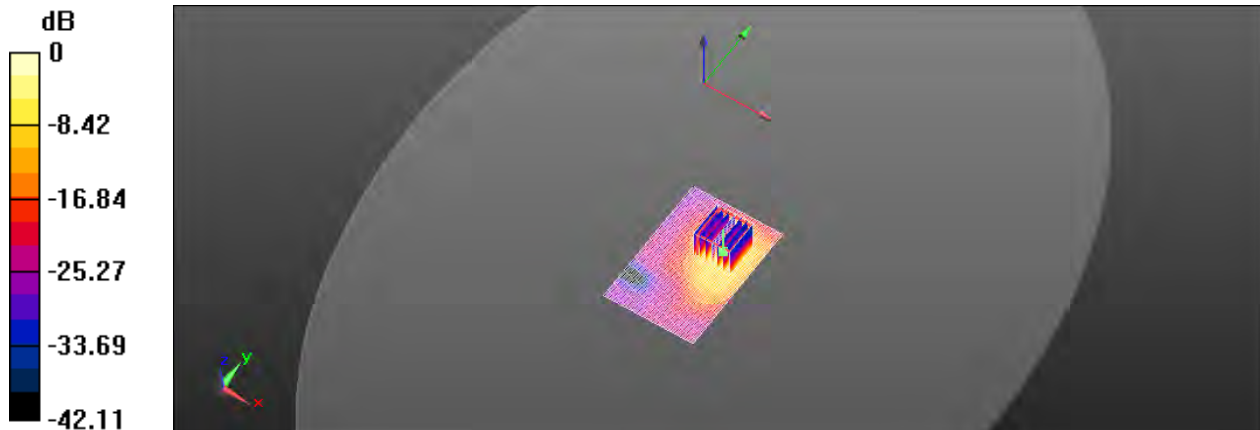
Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 2.438 V/m; Power Drift = -0.11 dB

Peak SAR (extrapolated) = 25.6 W/kg

SAR(1 g) = 4.83 W/kg; SAR(10 g) = 1.18 W/kg

Maximum value of SAR (measured) = 11.2 W/kg



0 dB = 11.2 W/kg = 10.49 dBW/kg

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Date: 2019/3/20

WLAN 802.11b_Body_3-1_CH 6_Tx2_0mm

Communication System: WLAN 2.45G; Frequency: 2437 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 2437$ MHz; $\sigma = 2.004$ S/m; $\epsilon_r = 51.014$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Ambient temperature: 21.7°C; Liquid temperature: 21.9°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3938; ConvF(7.3, 7.3, 7.3); Calibrated: 2018/10/24
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1260; Calibrated: 2018/11/30
- Phantom: ELI
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Area Scan (81x121x1): Interpolated grid: dx=12 mm, dy=12 mm

Maximum value of SAR (interpolated) = 0.0347 W/kg

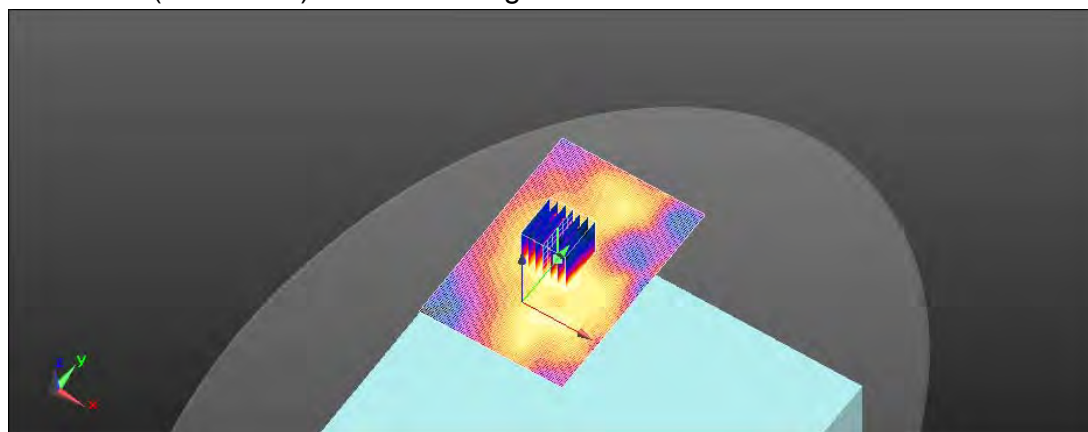
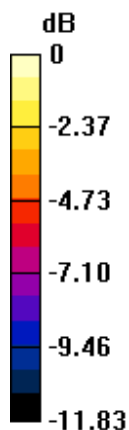
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 2.491 V/m; Power Drift = 0.11 dB

Peak SAR (extrapolated) = 0.0430 W/kg

SAR(1 g) = 0.023 W/kg; SAR(10 g) = 0.014 W/kg

Maximum value of SAR (measured) = 0.0321 W/kg



0 dB = 0.0321 W/kg = -14.93 dBW/kg

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Date: 2019/3/20

WLAN 802.11b_Extremity_1_CH 6_Tx2_0mm

Communication System: WLAN 2.45G; Frequency: 2437 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 2437$ MHz; $\sigma = 2.004$ S/m; $\epsilon_r = 51.014$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Ambient temperature: 21.7°C; Liquid temperature: 21.9°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3938;ConvF(7.3, 7.3, 7.3);Calibrated: 2018/10/24
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1260; Calibrated: 2018/11/30
- Phantom: ELI
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Area Scan (71x101x1): Interpolated grid: dx=12 mm, dy=12 mm

Maximum value of SAR (interpolated) = 2.44 W/kg

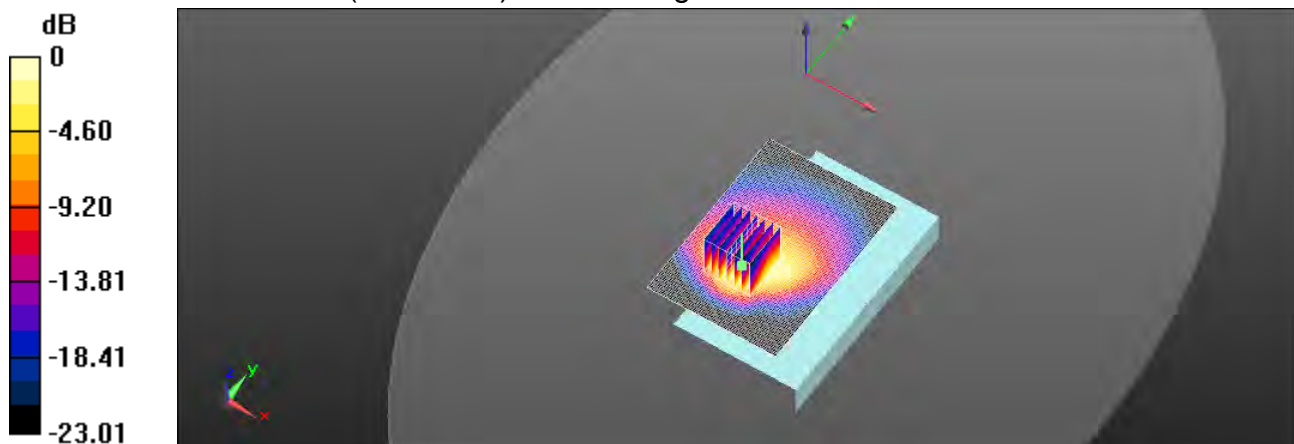
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 2.553 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 3.26 W/kg

SAR(1 g) = 1.43 W/kg; SAR(10 g) = 0.694 W/kg

Maximum value of SAR (measured) = 2.16 W/kg



0 dB = 2.16 W/kg = 3.34 dBW/kg

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Date: 2019/3/21

WLAN802.11a 5.2G Body 3-1_CH 48_Tx2_0mm

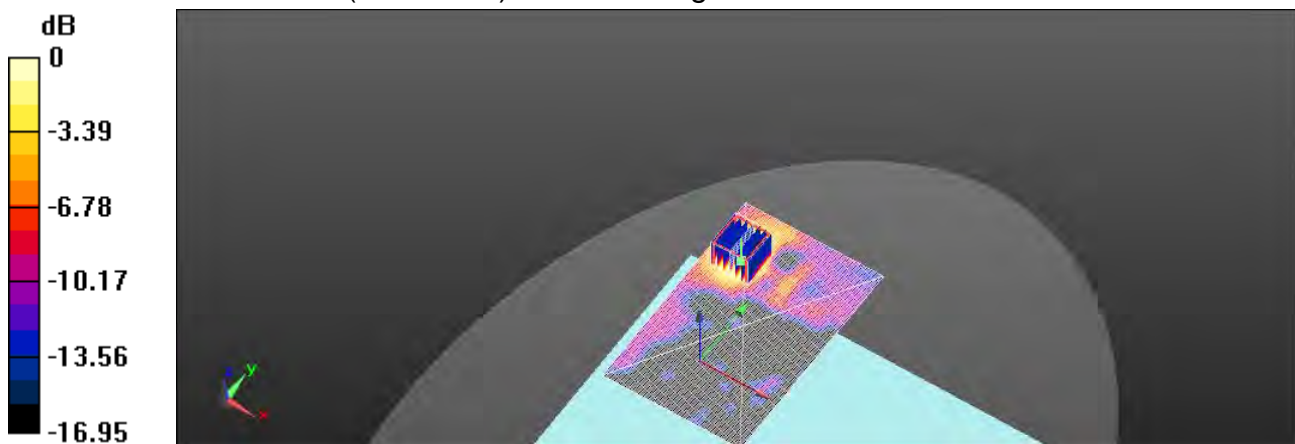
Communication System: WLAN 5G; Frequency: 5240 MHz
Medium parameters used: $f = 5240 \text{ MHz}$; $\sigma = 5.231 \text{ S/m}$; $\epsilon_r = 48.989$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section
Ambient temperature: 21.9°C ; Liquid temperature: 22.2°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3938;ConvF(4.23, 4.23, 4.23);Calibrated: 2018/10/24
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1260; Calibrated: 2018/11/30
- Phantom: ELI
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Area Scan (91x141x1): Interpolated grid: $dx=10 \text{ mm}$, $dy=10 \text{ mm}$
Maximum value of SAR (interpolated) = 0.236 W/kg

Zoom Scan (7x7x12)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=2\text{mm}$
Reference Value = 2.756 V/m ; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 0.405 W/kg
SAR(1 g) = 0.123 W/kg ; SAR(10 g) = 0.051 W/kg
Maximum value of SAR (measured) = 0.223 W/kg



0 dB = 0.223 W/kg = -6.52 dBW/kg

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Date: 2019/3/21

WLAN802.11a 5.2G Extremity_1_CH 48_Tx2_0mm

Communication System: WLAN 5G; Frequency: 5240 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 5240 \text{ MHz}$; $\sigma = 5.231 \text{ S/m}$; $\epsilon_r = 48.989$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Ambient temperature: 21.9°C; Liquid temperature: 22.2°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3938;ConvF(4.23, 4.23, 4.23);Calibrated: 2018/10/24
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1260; Calibrated: 2018/11/30
- Phantom: ELI
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Area Scan (81x121x1): Interpolated grid: dx=10 mm, dy=10 mm

Maximum value of SAR (interpolated) = 4.48 W/kg

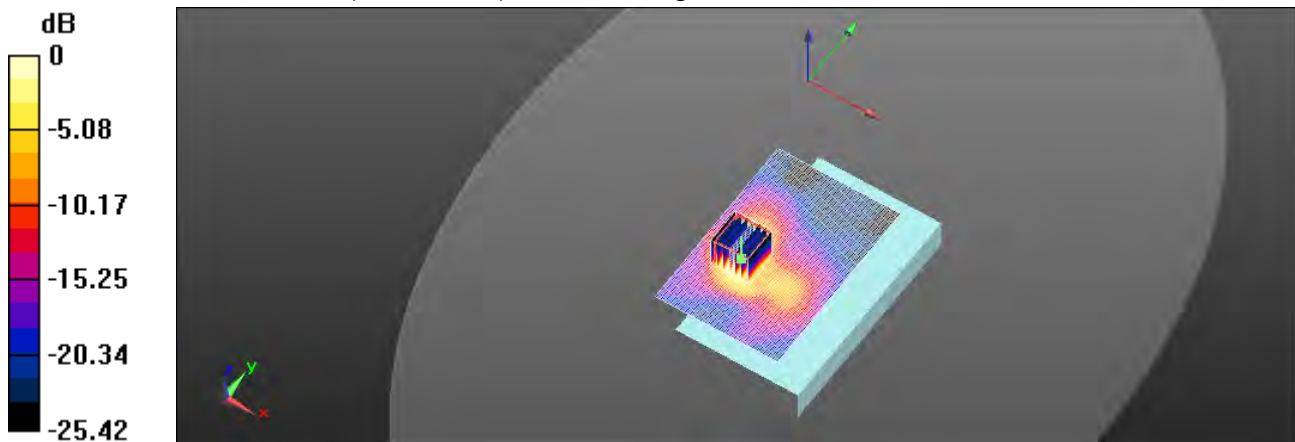
Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 2.289 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 7.44 W/kg

SAR(1 g) = 2.07 W/kg; SAR(10 g) = 0.731 W/kg

Maximum value of SAR (measured) = 3.85 W/kg



0 dB = 3.85 W/kg = 5.85 dBW/kg

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Date: 2019/3/22

WLAN802.11a 5.3G Body_3-1_CH 56_Tx2_0mm

Communication System: WLAN 5G; Frequency: 5280 MHz

Medium parameters used: $f = 5280 \text{ MHz}$; $\sigma = 5.305 \text{ S/m}$; $\epsilon_r = 48.863$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Ambient temperature: 21.8°C ; Liquid temperature: 22.2°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3938;ConvF(4.23, 4.23, 4.23);Calibrated: 2018/10/24
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1260; Calibrated: 2018/11/30
- Phantom: ELI
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Area Scan (91x121x1): Interpolated grid: $dx=10 \text{ mm}$, $dy=10 \text{ mm}$

Maximum value of SAR (interpolated) = 0.252 W/kg

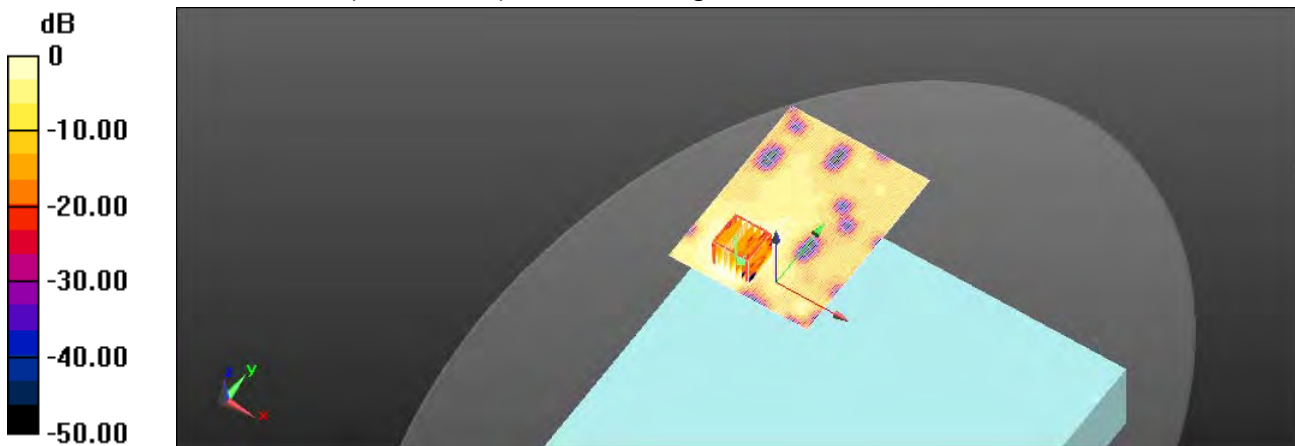
Zoom Scan (7x7x12)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=2\text{mm}$

Reference Value = 2.452 V/m ; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 0.411 W/kg

SAR(1 g) = 0.138 W/kg ; SAR(10 g) = 0.049 W/kg

Maximum value of SAR (measured) = 0.251 W/kg



0 dB = $0.251 \text{ W/kg} = -6.00 \text{ dBW/kg}$

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Date: 2019/3/22

WLAN802.11a 5.3G Extremity_1_CH 52_Tx2_0mm

Communication System: WLAN 5G; Frequency: 5260 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 5260$ MHz; $\sigma = 5.271$ S/m; $\epsilon_r = 48.904$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Ambient temperature: 21.8°C; Liquid temperature: 22.2°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3938;ConvF(4.23, 4.23, 4.23);Calibrated: 2018/10/24
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1260; Calibrated: 2018/11/30
- Phantom: ELI
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Area Scan (81x121x1): Interpolated grid: dx=10 mm, dy=10 mm

Maximum value of SAR (interpolated) = 4.70 W/kg

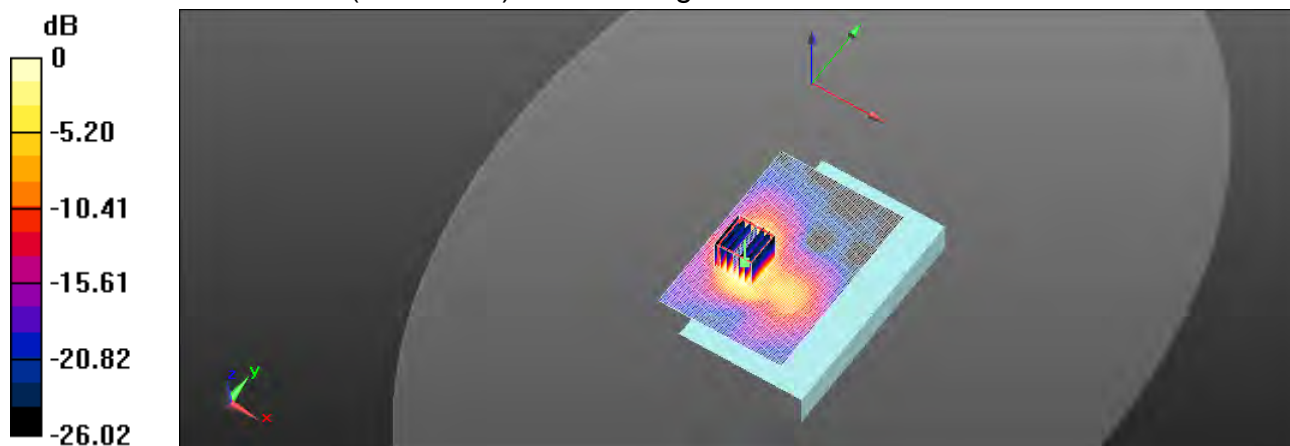
Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 2.442 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 8.04 W/kg

SAR(1 g) = 2.22 W/kg; SAR(10 g) = 0.781 W/kg

Maximum value of SAR (measured) = 4.12 W/kg



0 dB = 4.12 W/kg = 6.15 dBW/kg

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Date: 2019/3/23

WLAN802.11a 5.6G Body 3-1_CH 116_Tx2_0mm

Communication System: WLAN 5G; Frequency: 5580 MHz
Medium parameters used: $f = 5580$ MHz; $\sigma = 5.793$ S/m; $\epsilon_r = 47.915$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Ambient temperature: 22.0°C; Liquid temperature: 21.7°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3938; ConvF(3.77, 3.77, 3.77); Calibrated: 2018/10/24
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1260; Calibrated: 2018/11/30
- Phantom: ELI
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Area Scan (91x121x1): Interpolated grid: dx=10 mm, dy=10 mm

Maximum value of SAR (interpolated) = 0.133 W/kg

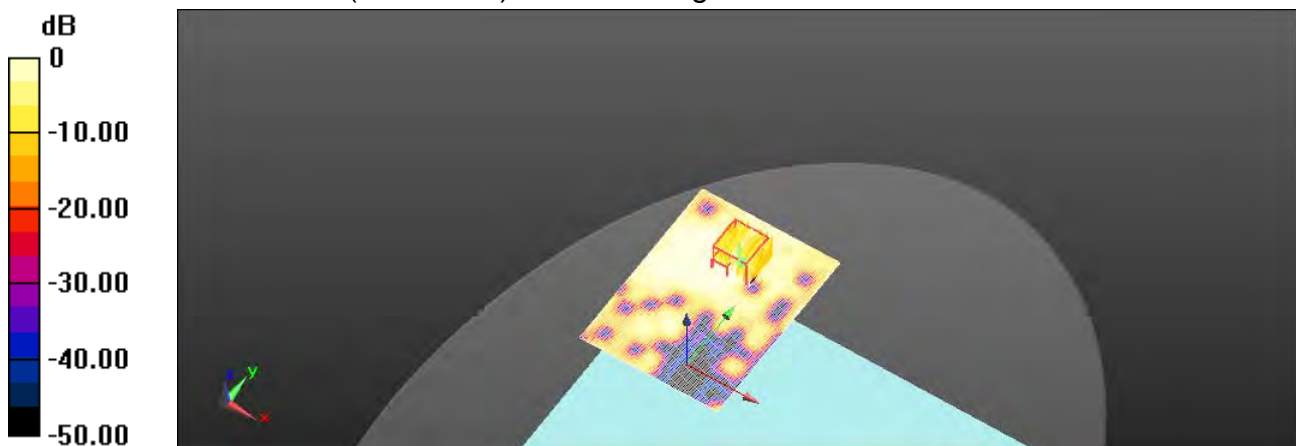
Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 2.128 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 0.371 W/kg

SAR(1 g) = 0.059 W/kg; SAR(10 g) = 0.028 W/kg

Maximum value of SAR (measured) = 0.113 W/kg



0 dB = 0.113 W/kg = -9.47 dBW/kg

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Date: 2019/3/23

WLAN802.11a 5.6G Extremity_1_CH 116_Tx2_0mm

Communication System: WLAN 5G; Frequency: 5580 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 5580 \text{ MHz}$; $\sigma = 5.793 \text{ S/m}$; $\epsilon_r = 47.915$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Ambient temperature: 22.0°C; Liquid temperature: 21.7°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3938;ConvF(3.77, 3.77, 3.77);Calibrated: 2018/10/24
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1260; Calibrated: 2018/11/30
- Phantom: ELI
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Area Scan (81x121x1): Interpolated grid: dx=10 mm, dy=10 mm

Maximum value of SAR (interpolated) = 3.69 W/kg

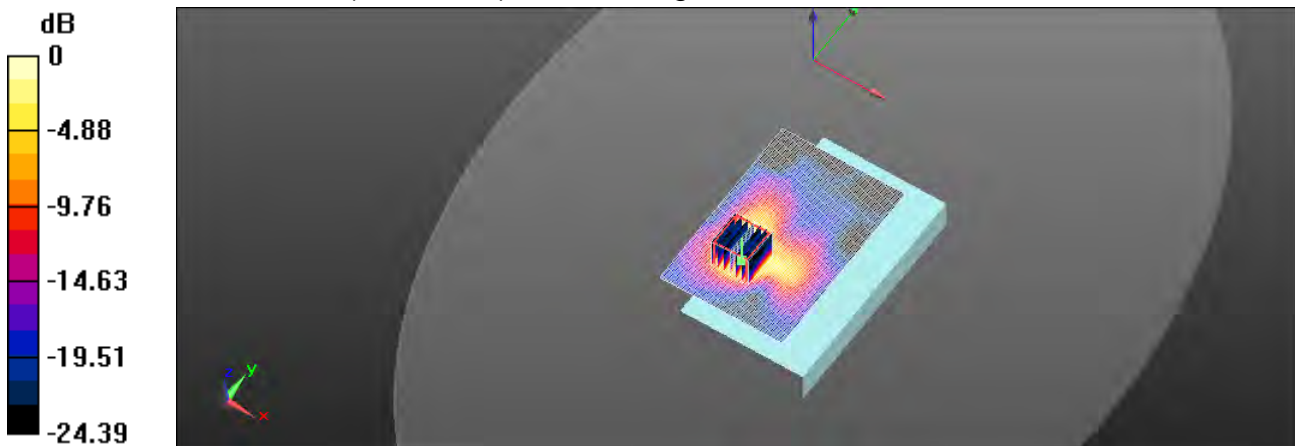
Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 2.722 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 7.33 W/kg

SAR(1 g) = 1.83 W/kg; SAR(10 g) = 0.640 W/kg

Maximum value of SAR (measured) = 3.65 W/kg



0 dB = 3.65 W/kg = 5.62 dBW/kg

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Date: 2019/3/24

WLAN802.11a 5.8G Body_3-1_CH 165_Tx2_0mm

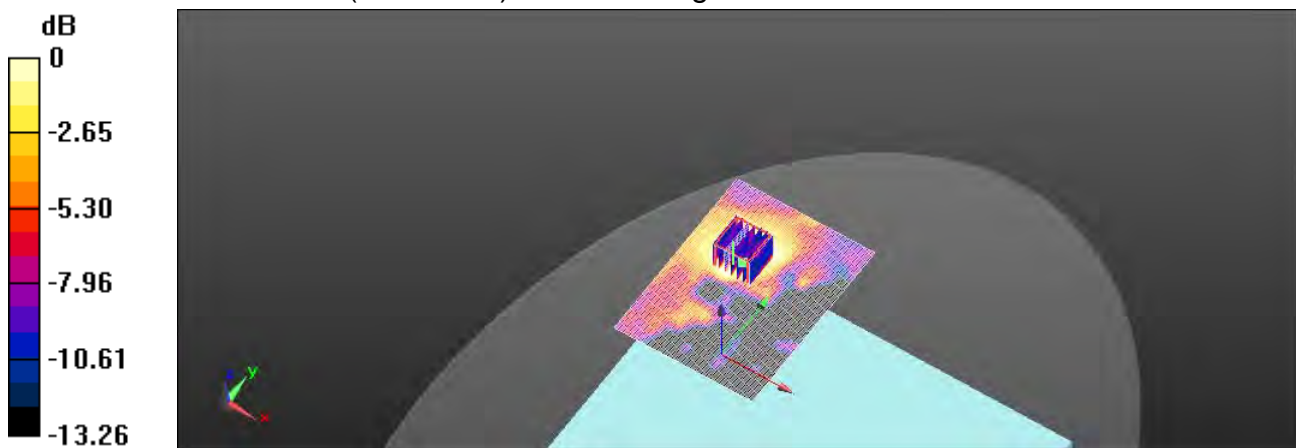
Communication System: WLAN 5G; Frequency: 5825 MHz
Medium parameters used: $f = 5825 \text{ MHz}$; $\sigma = 6.184 \text{ S/m}$; $\epsilon_r = 47.228$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section
Ambient temperature: 22.2°C ; Liquid temperature: 21.9°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3938; ConvF(4, 4, 4); Calibrated: 2018/10/24
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1260; Calibrated: 2018/11/30
- Phantom: ELI
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Area Scan (91x121x1): Interpolated grid: $dx=10 \text{ mm}$, $dy=10 \text{ mm}$
Maximum value of SAR (interpolated) = 0.139 W/kg

Zoom Scan (7x7x12)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=2\text{mm}$
Reference Value = 2.612 V/m ; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 0.306 W/kg
SAR(1 g) = 0.065 W/kg ; SAR(10 g) = 0.033 W/kg
Maximum value of SAR (measured) = 0.120 W/kg



0 dB = 0.120 W/kg = -9.21 dBW/kg

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Date: 2019/3/24

WLAN802.11a 5.8G Extremity_1_CH 165_Tx2_0mm

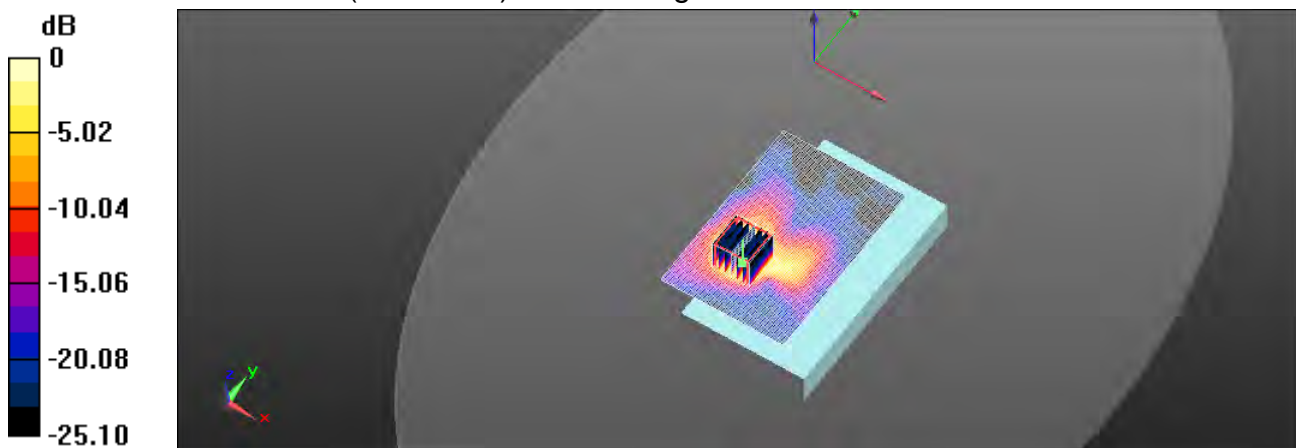
Communication System: WLAN 5G; Frequency: 5825 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 5825 \text{ MHz}$; $\sigma = 6.184 \text{ S/m}$; $\epsilon_r = 47.228$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section
Ambient temperature: 22.2°C ; Liquid temperature: 21.9°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3938;ConvF(4, 4, 4);Calibrated: 2018/10/24
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1260; Calibrated: 2018/11/30
- Phantom: ELI
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Area Scan (81x121x1): Interpolated grid: $dx=10 \text{ mm}$, $dy=10 \text{ mm}$
Maximum value of SAR (interpolated) = 3.83 W/kg

Zoom Scan (7x7x12)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=2\text{mm}$
Reference Value = 2.962 V/m ; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 8.64 W/kg
SAR(1 g) = 1.95 W/kg ; SAR(10 g) = 0.638 W/kg
Maximum value of SAR (measured) = 4.09 W/kg



0 dB = $4.09 \text{ W/kg} = 6.12 \text{ dBW/kg}$

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6. SAR System Performance Verification

Date: 2019/3/20

Dipole 2450 MHz_SN:727

Communication System: CW; Frequency: 2450 MHz

 Medium parameters used: $f = 2450$ MHz; $\sigma = 2.019$ S/m; $\epsilon_r = 50.982$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Ambient temperature: 21.7°C; Liquid temperature: 21.9°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3938;ConvF(7.3, 7.3, 7.3);Calibrated: 2018/10/24
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1260; Calibrated: 2018/11/30
- Phantom: ELI
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Pin=250mW/Area Scan (51x51x1): Interpolated grid: dx=12 mm, dy=12 mm

Maximum value of SAR (interpolated) = 20.6 W/kg

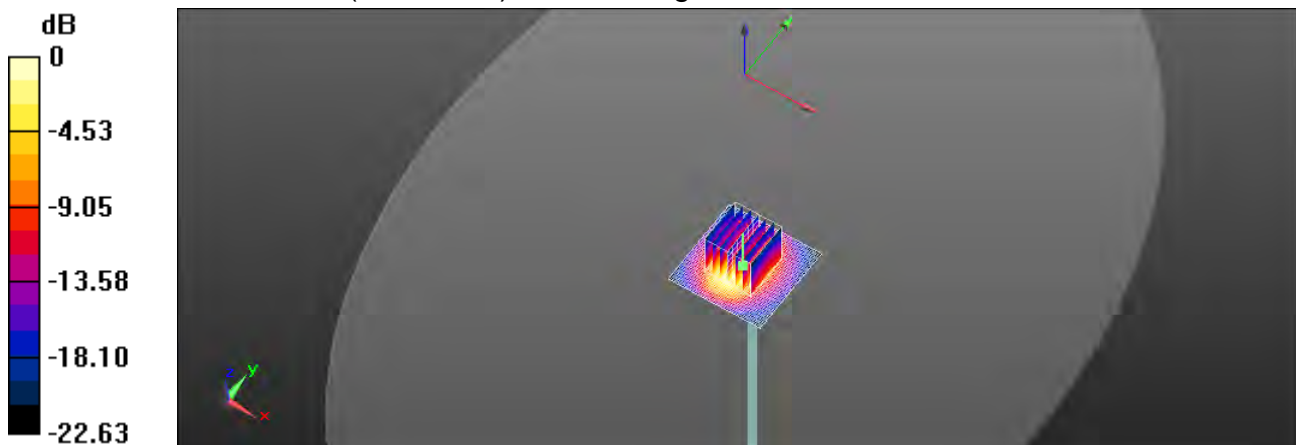
Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 97.88 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 26.0 W/kg

SAR(1 g) = 12.6 W/kg; SAR(10 g) = 5.76 W/kg

Maximum value of SAR (measured) = 19.3 W/kg



0 dB = 19.3 W/kg = 12.86 dBW/kg

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Date: 2019/3/21

Dipole 5200 MHz_SN:1040

Communication System: CW; Frequency: 5200 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 5200$ MHz; $\sigma = 5.164$ S/m; $\epsilon_r = 49.157$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Ambient temperature: 21.9°C; Liquid temperature: 22.2°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3938;ConvF(4.23, 4.23, 4.23);Calibrated: 2018/10/24
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1260; Calibrated: 2018/11/30
- Phantom: ELI
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Pin=100mW/Area Scan (51x51x1): Interpolated grid: dx=10 mm, dy=10 mm
Maximum value of SAR (interpolated) = 14.7 W/kg

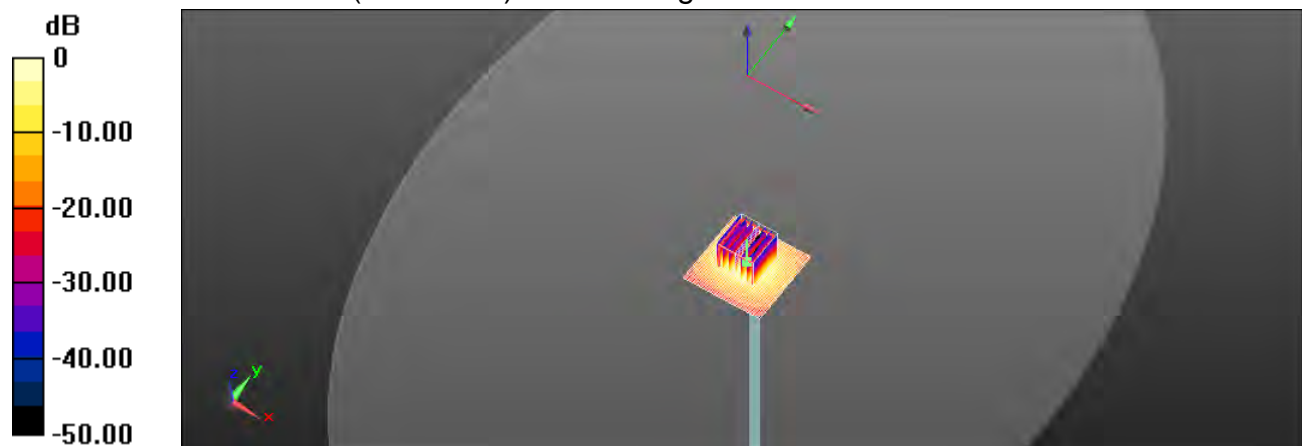
Pin=100mW/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 56.01 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 32.8 W/kg

SAR(1 g) = 7.20 W/kg; SAR(10 g) = 1.99 W/kg

Maximum value of SAR (measured) = 15.4 W/kg



0 dB = 15.4 W/kg = 11.88 dBW/kg

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Date: 2019/3/22

Dipole 5300 MHz_SN:1040

Communication System: CW; Frequency: 5300 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 5300 \text{ MHz}$; $\sigma = 5.331 \text{ S/m}$; $\epsilon_r = 48.827$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Ambient temperature: 21.8°C; Liquid temperature: 22.2°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3938;ConvF(4.23, 4.23, 4.23);Calibrated: 2018/10/24
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1260; Calibrated: 2018/11/30
- Phantom: ELI
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Pin=100mW/Area Scan (51x51x1): Interpolated grid: dx=10 mm, dy=10 mm

Maximum value of SAR (interpolated) = 16.2 W/kg

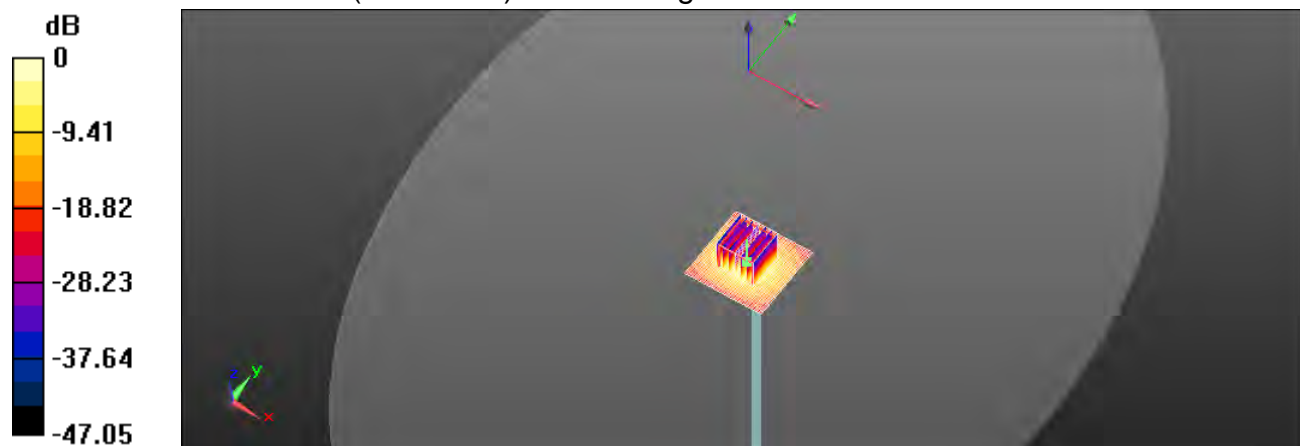
Pin=100mW/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 59.76 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 31.8 W/kg

SAR(1 g) = 7.49 W/kg; SAR(10 g) = 2.09 W/kg

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



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

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Date: 2019/3/23

Dipole 5600 MHz_SN:1040

Communication System: CW; Frequency: 5600 MHz

Medium parameters used: $f = 5600 \text{ MHz}$; $\sigma = 5.821 \text{ S/m}$; $\epsilon_r = 47.871$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Ambient temperature: 22.0°C ; Liquid temperature: 21.7°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3938;ConvF(3.77, 3.77, 3.77);Calibrated: 2018/10/24
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1260; Calibrated: 2018/11/30
- Phantom: ELI
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Pin=100mW/Area Scan (51x51x1): Interpolated grid: $dx=10 \text{ mm}$, $dy=10 \text{ mm}$

Maximum value of SAR (interpolated) = 17.4 W/kg

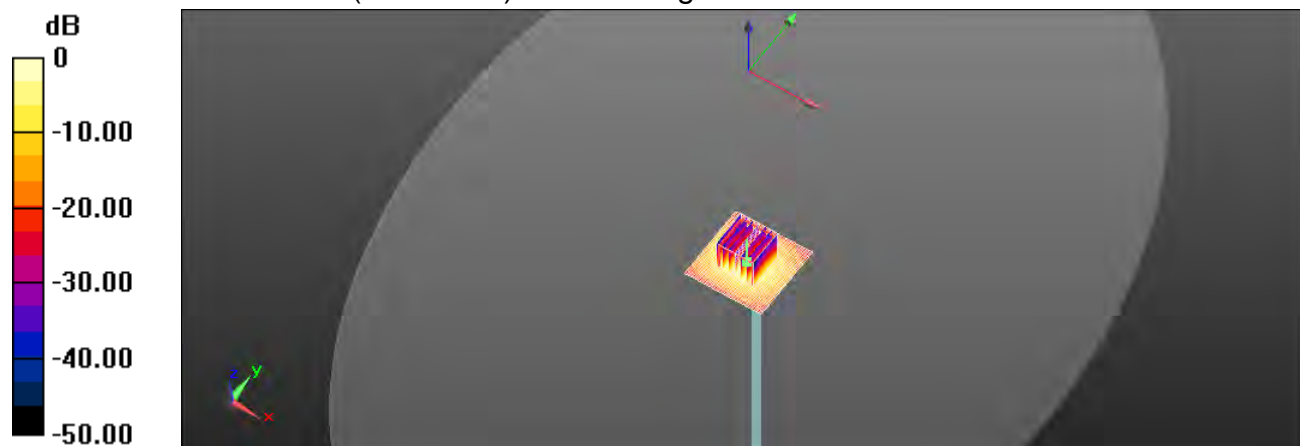
Pin=100mW/Zoom Scan (7x7x12)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=2\text{mm}$

Reference Value = 58.76 V/m ; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 34.1 W/kg

SAR(1 g) = 7.84 W/kg ; SAR(10 g) = 2.17 W/kg

Maximum value of SAR (measured) = 16.8 W/kg



0 dB = $16.8 \text{ W/kg} = 12.25 \text{ dBW/kg}$

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Date: 2019/3/24

Dipole 5800 MHz_SN:1040

Communication System: CW; Frequency: 5800 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 5800$ MHz; $\sigma = 6.167$ S/m; $\epsilon_r = 47.243$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Ambient temperature: 22.2°C; Liquid temperature: 21.9°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3938;ConvF(4, 4, 4);Calibrated: 2018/10/24
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1260; Calibrated: 2018/11/30
- Phantom: ELI
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Pin=100mW/Area Scan (51x51x1): Interpolated grid: dx=10 mm, dy=10 mm
Maximum value of SAR (interpolated) = 16.8 W/kg

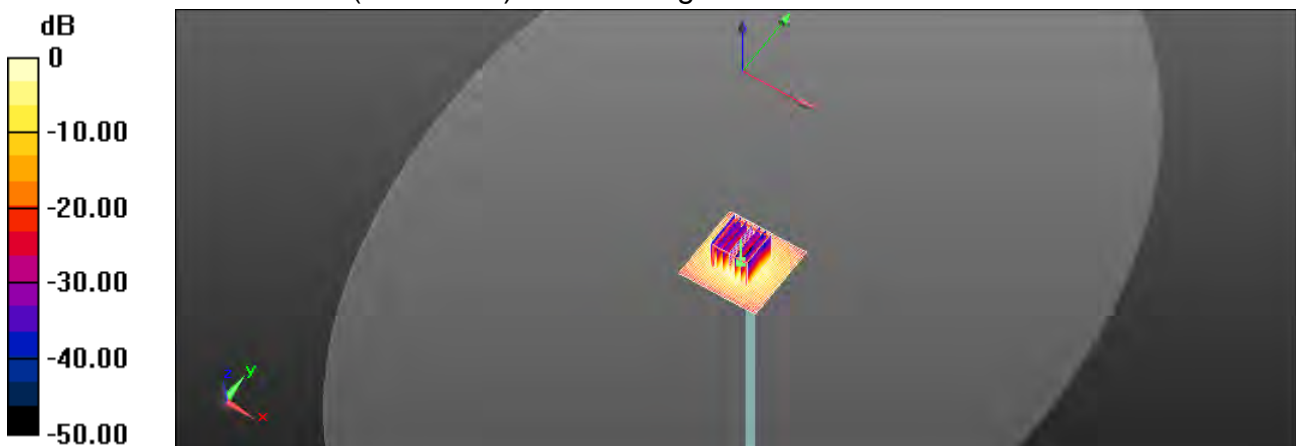
Pin=100mW/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 56.76 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 37.0 W/kg

SAR(1 g) = 7.57 W/kg; SAR(10 g) = 2.09 W/kg

Maximum value of SAR (measured) = 16.7 W/kg



0 dB = 16.7 W/kg = 12.23 dBW/kg

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7. Uncertainty Budget

Measurement Uncertainty evaluation template for DUT SAR test (3-6G)

A	c	D	e		f	g	h=c * f / e	i=c * g / e	k
Source of Uncertainty	Tolerance/ Uncertainty	Probability Distributio	Div	Div Value	ci (1g)	ci (10g)	Standard uncertainty	Standard uncertainty	vi, or Veff
Measurement system									
Probe calibration	6.55%	N	1	1	1	1	6.55%	6.55%	∞
<i>Isotropy, Axial</i>	3.50%	R	√3	1.732	1	1	2.02%	2.02%	∞
<i>Isotropy, Hemispherical</i>	9.60%	R	√3	1.732	1	1	5.54%	5.54%	∞
Modulation Response	2.40%	R	√3	1.732	1	1	1.40%	1.40%	∞
Boundary Effect	1.00%	R	√3	1.732	1	1	0.58%	0.58%	∞
Linearity	4.70%	R	√3	1.732	1	1	2.71%	2.71%	∞
Detection Limits	1.00%	R	√3	1.732	1	1	0.58%	0.58%	∞
Readout Electronics	0.30%	N	1	1	1	1	0.30%	0.30%	∞
Response time	0.80%	R	√3	1.732	1	1	0.46%	0.46%	∞
Integration Time	2.60%	R	√3	1.732	1	1	1.50%	1.50%	∞
Measurement drift (class A evaluation)	1.75%	R	√3	1.732	1	1	1.01%	1.01%	∞
RF ambient condition - noise	3.00%	R	√3	1.732	1	1	1.73%	1.73%	∞
RF ambient conditions - reflections	3.00%	R	√3	1.732	1	1	1.73%	1.73%	∞
Probe positioner Mechanical restrictions	0.40%	R	√3	1.732	1	1	0.23%	0.23%	∞
Probe Positioning with respect to phantom shell	2.90%	R	√3	1.732	1	1	1.67%	1.67%	∞
Post-processing	1.00%	R	√3	1.732	1	1	0.58%	0.58%	∞
Max SAR Eval	1.00%	R	√3	1.732	1	1	0.58%	0.58%	∞
Test Sample related									
Test sample positioning	2.90%	N	1	1	1	1	2.90%	2.90%	M-1
Device Holder Uncertainty	3.60%	N	1	1	1	1	3.60%	3.60%	M-1
Drift of output power	5.00%	R	√3	1.732	1	1	2.89%	2.89%	∞
Phantom and Setup									
Phantom Uncertainty	4.00%	R	√3	1.732	1	1	2.31%	2.31%	∞
Liquid permittivity (mea.)	1.99%	N	1	1	0.64	0.43	1.27%	0.86%	M
Liquid Conductivity (mea.)	2.78%	N	1	1	0.6	0.49	1.67%	1.36%	M
Combined standard uncertainty		RSS					11.90%	11.82%	
Expart uncertainty (95% confidence interval), K=2							23.81%	23.63%	

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Measurement Uncertainty evaluation template for DUT SAR test (0.3-3G)

A	c	D	e		f	g	$h=c * f / e$	$i=c * g / e$	k
Source of Uncertainty	Tolerance/ Uncertainty	Probability Distributio	Div	Div Value	ci (1g)	ci (10g)	Standard uncertainty	Standard uncertainty	v_i , or V_{eff}
Measurement system									
Probe calibration	6.00%	N	1	1	1	1	6.00%	6.00%	∞
<i>Isotropy, Axial</i>	3.50%	R	$\sqrt{3}$	1.732	1	1	2.02%	2.02%	∞
<i>Isotropy, Hemispherical</i>	9.60%	R	$\sqrt{3}$	1.732	1	1	5.54%	5.54%	∞
Modulation Response	2.40%	R	$\sqrt{3}$	1.732	1	1	1.40%	1.40%	∞
Boundary Effect	1.00%	R	$\sqrt{3}$	1.732	1	1	0.58%	0.58%	∞
Linearity	4.70%	R	$\sqrt{3}$	1.732	1	1	2.71%	2.71%	∞
Detection Limits	1.00%	R	$\sqrt{3}$	1.732	1	1	0.58%	0.58%	∞
Readout Electronics	0.30%	N	1	1	1	1	0.30%	0.30%	∞
Response time	0.80%	R	$\sqrt{3}$	1.732	1	1	0.46%	0.46%	∞
Integration Time	2.60%	R	$\sqrt{3}$	1.732	1	1	1.50%	1.50%	∞
Measurement drift (class A evaluation)									
RF ambient condition - noise	3.00%	R	$\sqrt{3}$	1.732	1	1	1.73%	1.73%	∞
RF ambient conditions - reflections	3.00%	R	$\sqrt{3}$	1.732	1	1	1.73%	1.73%	∞
Probe positioner Mechanical restrictions	0.40%	R	$\sqrt{3}$	1.732	1	1	0.23%	0.23%	∞
Probe Positioning with respect to phantom shell	2.90%	R	$\sqrt{3}$	1.732	1	1	1.67%	1.67%	∞
Post-processing	1.00%	R	$\sqrt{3}$	1.732	1	1	0.58%	0.58%	∞
Max SAR Eval	1.00%	R	$\sqrt{3}$	1.732	1	1	0.58%	0.58%	∞
Test Sample related									
Test sample positioning	2.90%	N	1	1	1	1	2.90%	2.90%	M-1
Device Holder Uncertainty	3.60%	N	1	1	1	1	3.60%	3.60%	M-1
Drift of output power	5.00%	R	$\sqrt{3}$	1.732	1	1	2.89%	2.89%	∞
Phantom and Setup									
Phantom Uncertainty	4.00%	R	$\sqrt{3}$	1.732	1	1	2.31%	2.31%	∞
Liquid permittivity (mea.)	3.37%	N	1	1	0.64	0.43	2.16%	1.45%	M
Liquid Conductivity (mea.)	3.54%	N	1	1	0.6	0.49	2.12%	1.73%	M
Combined standard uncertainty		RSS					11.81%	11.63%	
Expant uncertainty (95% confidence interval), K=2							23.62%	23.26%	

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Appendixes

Refer to separated files for the following appendixes.

ES201930008 SAR_Appendix A Photographs

ES201930008 SAR_Appendix B DAE & Probe Cal. Certificate

ES201930008 SAR_Appendix C Phantom Description & Dipole Cal. Certificate

- End of report -

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