LTE Band38

BW (MHz)	Frequency (MHz)	RB Configuration		Average Power [dBm]	
		Size	Offset	QPSK	16QAM
5	2572.5	1	0	20.03	19.87
		1	12	20.11	20.14
		1	24	20.31	20.22
		12	0	19.52	18.53
		12	6	19.54	18.55
		12	13	19.69	18.68
		25	0	19.57	18.78
	2595.0	1	0	20.41	20.18
		1	12	20.28	20.08
		1	24	20.10	19.71
		12	0	19.64	18.79
		12	6	19.66	18.80
		12	13	19.59	18.56
		25	0	19.65	18.82
	2617.5	1	0	19.20	18.67
		1	12	19.27	18.60
		1	24	19.33	18.82
		12	0	18.89	17.81
		12	6	18.75	17.81
		12	13	18.91	17.95
		25	0	18.77	17.79
10	2575.0	1	0	20.01	19.65
		1	24	20.20	19.83
		1	49	20.39	20.05
		25	0	19.64	18.72
		25	12	19.64	18.70
		25	25	19.85	18.80
		50	0	19.74	18.84
	2595.0	1	0	20.13	19.84
		1	24	20.09	19.68
		1	49	19.76	19.44
		25	0	19.70	18.77
		25	12	19.71	18.87
		25	25	19.48	18.63
		50	0	19.63	18.75
	2615.0	1	0	19.17	18.69
		1	24	19.14	18.70
		1	49	19.28	19.09
		25	0	18.79	17.95
		25	12	18.81	17.97
		25	25	18.90	17.99
		50	0	18.86	17.80
15	2577.5	1	0	19.97	19.67
		1	37	20.23	19.97
		1	74	20.46	20.17
		37	0	19.84	19.86
		37	18	19.86	19.85
		37	38	19.84	19.85
		75	0	19.85	18.85
	2595.0	1	0	20.30	19.96
		1	37	20.14	19.70
		1	74	19.69	19.41
		37	0	19.51	19.52

		37	18	19.50	19.50
		37	38	19.51	19.50
		75	0	19.50	18.76
	2612.5	1	0	19.44	18.96
		1	37	19.14	18.80
		1	74	19.35	18.90
		37	0	18.82	18.82
		37	18	18.82	18.82
		37	38	18.82	18.82
		75	0	18.82	17.97
20	2580.0	1	0	19.95	19.80
		1	49	20.48	20.34
		1	99	20.43	20.43
		50	0	19.63	18.93
		50	25	19.66	18.94
		50	50	19.98	19.24
		100	0	19.98	19.06
	2595.0	1	0	20.63	20.16
		1	49	20.36	19.77
		1	99	19.98	19.25
		50	0	19.86	18.99
		50	25	19.89	18.98
		50	50	19.45	18.66
		100	0	19.75	18.83
	2610.0	1	0	19.92	19.03
		1	49	19.47	18.58
		1	99	19.53	18.68
		50	0	19.02	18.17
		50	25	19.03	18.18
		50	50	18.87	17.95
		100	0	18.94	18.09

LTE Band41

BW (MHz)	Frequency (MHz)	RB Configuration		Average Power [dBm]	
		Size	Offset	QPSK	16QAM
5	2498.5	1	0	20.00	19.94
		1	12	20.02	19.91
		1	24	19.92	19.92
		12	0	19.52	18.52
		12	6	19.52	18.52
		12	13	19.51	18.45
		25	0	19.45	18.55
	2593.0	1	0	20.43	20.40
		1	12	20.27	20.34
		1	24	20.27	20.22
		12	0	19.85	18.87
		12	6	19.87	18.89
		12	13	19.83	18.73
		25	0	19.87	18.90
	2687.5	1	0	19.74	19.76
		1	12	19.77	19.90
		1	24	19.86	19.67
		12	0	19.39	18.41
		12	6	19.40	18.41
		12	13	19.25	18.38
		25	0	19.26	18.44
10	2501.0	1	0	19.69	19.46
		1	24	19.81	19.49
		1	49	19.66	19.27
		25	0	19.33	18.55
		25	12	19.33	18.38
		25	25	19.37	18.29
		50	0	19.26	18.41
	2593.0	1	0	20.26	19.96
		1	24	20.24	19.81
		1	49	20.02	19.66
		25	0	19.87	18.93
		25	12	19.89	18.92
		25	25	19.69	18.75
		50	0	19.77	18.86
	2685.0	1	0	19.43	19.05
		1	24	19.65	19.36
		1	49	19.71	19.38
		25	0	19.07	18.24
		25	12	19.08	18.24
		25	25	19.28	18.29
		50	0	19.23	18.29
15	2503.5	1	0	19.83	19.46
		1	37	19.75	19.46
		1	74	19.60	19.26
		37	0	19.28	19.28
		37	18	19.27	19.26
		37	38	19.26	19.26
		75	0	19.27	18.27
	2593.0	1	0	20.42	19.90
		1	37	20.14	19.75
		1	74	19.86	19.53
		37	0	19.69	19.84

		37	18	19.65	19.65
		37	38	19.65	19.84
		75	0	19.84	18.92
	2682.5	1	0	19.23	18.87
		1	37	19.55	19.28
		1	74	19.64	19.41
		37	0	19.20	19.19
		37	18	19.19	19.19
		37	38	19.19	19.18
		75	0	19.18	18.32
20	2506.0	1	0	19.95	19.93
		1	49	19.89	19.77
		1	99	19.57	19.55
		50	0	19.46	18.56
		50	25	19.47	18.56
		50	50	19.18	18.45
		100	0	19.25	18.30
	2593.0	1	0	20.52	20.60
		1	49	20.36	20.23
		1	99	19.88	19.74
		50	0	20.00	19.15
		50	25	20.04	19.15
		50	50	19.65	18.88
		100	0	19.79	18.97
	2680.0	1	0	19.42	19.27
		1	49	19.50	19.39
		1	99	19.85	19.70
		50	0	19.05	18.08
		50	25	18.94	18.09
		50	50	19.29	18.60
		100	0	19.02	18.15

<WLAN 2.4GHz Conducted Power>

Mode	Channel	Frequency (MHz)	Data rate (Mbps)	Average Output Power (dBm)
IEEE 802.11b	1	2412	1	14.78
			2	14.73
			5.5	14.66
			11	14.60
	6	2437	1	14.56
			2	14.52
			5.5	14.47
			11	14.42
	11	2462	1	14.42
			2	14.35
			5.5	14.30
			11	14.24
IEEE 802.11g	1	2412	6	13.19
			9	13.12
			12	13.06
			18	13.00
			24	12.94
			36	12.88
			48	12.84
			54	12.79
	6	2437	6	13.37
			9	13.32

			12	13.26
			18	13.21
			24	13.17
			36	13.14
			48	13.08
			54	13.03
	11	2462	6	12.98
			9	12.93
			12	12.89
			18	12.83
			24	12.77
			36	12.73
			48	12.69
			54	12.66
IEEE 802.11n HT20	1	2412	MCS0	13.63
			MCS1	13.58
			MCS2	13.54
			MCS3	13.47
			MCS4	13.42
			MCS5	13.35
			MCS6	13.30
			MCS7	13.24
	6	2437	MCS0	13.51
			MCS1	13.44
			MCS2	13.39
			MCS3	13.32
			MCS4	13.24
			MCS5	13.17
			MCS6	13.13
			MCS7	13.05
	11	2462	MCS0	13.09
			MCS1	13.04
			MCS2	13.00
			MCS3	12.94
			MCS4	12.89
			MCS5	12.85
			MCS6	12.81
			MCS7	12.76
IEEE 802.11n HT40	3	2422	MCS0	12.27
			MCS1	12.22
			MCS2	12.14
			MCS3	12.06
			MCS4	12.00
			MCS5	11.95
			MCS6	11.90
			MCS7	11.84
	6	2437	MCS0	12.20
			MCS1	12.14
			MCS2	12.07
			MCS3	12.03
			MCS4	11.98
			MCS5	11.94
			MCS6	11.88
			MCS7	11.83
	9	2452	MCS0	11.93
			MCS1	11.88
			MCS2	11.83
			MCS3	11.79

			MCS4	11.72
			MCS5	11.73
			MCS6	11.68
			MCS7	11.62

Note:SAR is not required for the following 2.4 GHz OFDM conditions as 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.

<BT Conducted Power>

Mode	channel	Frequency (MHz)	Conducted AVG output power (dBm)
GFSK-BLE	0	2402	-0.25
	19	2440	0.17
	39	2480	0.21
GFSK	0	2402	1.46
	39	2441	1.88
	78	2480	2.14
π/4-DQPSK	0	2402	1.14
	39	2441	1.16
	78	2480	1.47
8DPSK	0	2402	1.27
	39	2441	1.25
	78	2480	1.82

Per KDB 447498 D01v06, the 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:
[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] ·[$\sqrt{f(GHz)}$] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR

- f(GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison

Bluetooth Tune up Power (dBm)	Separation Distance (mm)	Frequency (GHz)	Exclusion Thresholds
2.5	5	2.45	0.6

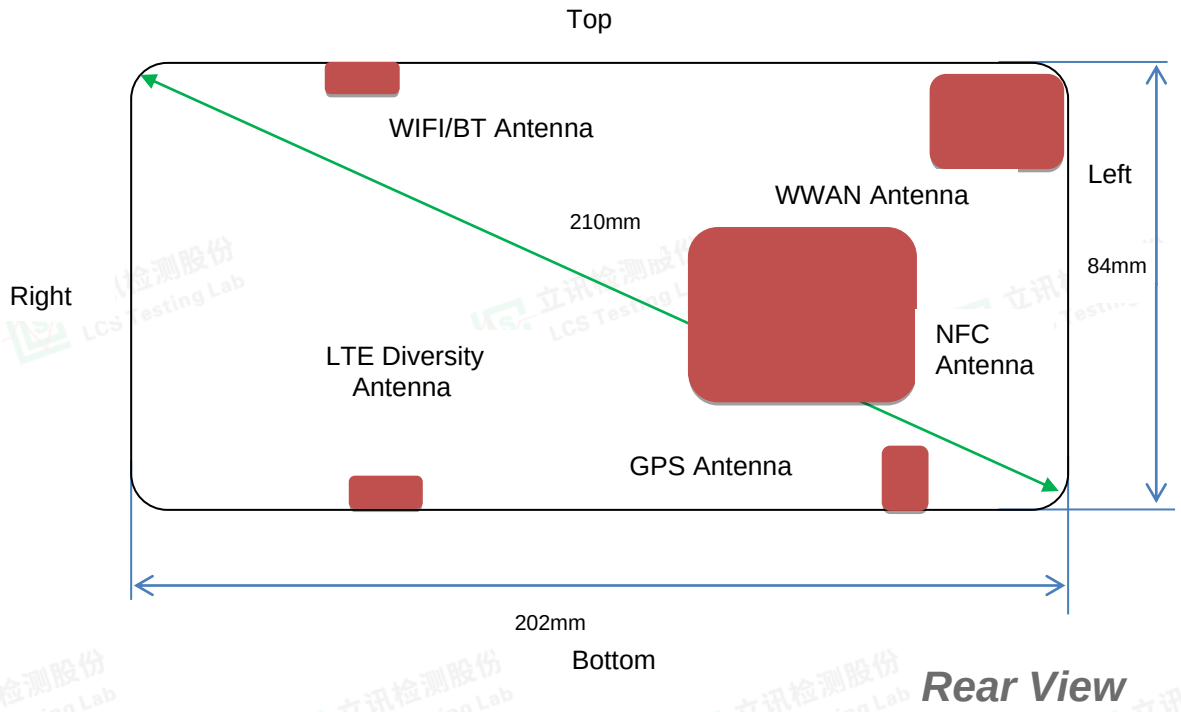
Per KDB 447498 D01v06, when the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion. The test exclusion threshold is 0.6< 3.0, SAR testing is not required.

Test Mode	Channel Frequency (MHz)	Field Strength (dBuV/m@3m)	Max Output Power(mW)	Calculate on Value(Note)	Threshold Value (mW)
NFC	13.56	52.88	0.00006	0.00006	443

Note:
1.Calculate the SAR test to eliminate thresholds from chapter 2 conditions"3" formula
2.Field Strength(dBuV/m@3m)=Field Strength(dBuV/m@30m)+40*log(30/3)
3. Max Power(dBm)=Field Strength of Fundamental(dBuV/m@3m)-95.23
4. Max Power (mW)=10^(Max power (dBmy10)

Since Source-base time average power is below SAR test exclusion power thresholds, the SAR evaluation is nel not required.

4.2. Transmit Antennas and SAR Measurement Position



Antenna information:

WLAN Antenna	WLAN TX/RX
WWAN Antenna	GSM/UMTS/LTE TX/RX

Note:
1). Per KDB648474 D04, because the overall diagonal distance of this devices is 220mm>160mm, it is considered as “Smart POS Terminal PC“ device.
2). Per KDB648474 D04, 10-g extremity SAR is not required when Body-Worn mode 1-g reported SAR < 1.2 W/Kg.
3). According to the KDB941225 D06 Hot Spot SAR v02, the edges with less than 25 mm distance to the antennas need to be tested for SAR.
4). Per KDB 616217 D04, The antennas in tablets are typically located near the back (bottom) surface and/or along the edges of the devices; therefore, SAR evaluation is required for these configurations. Exposures from antennas through the front (top) surface of the displaysection of a full-size tablet, away from the edges, are generally limited to the user’s hands.

Distance of The Antenna to the EUT surface and edge (mm)						
Antennas	**Front**	**Back**	**Top Side**	**Bottom Side**	**Left Side**	**Right Side**
WLAN	<5	<5	<5	51	<5	138
WWAN/BT	<5	<5	<5	69	136	59

Positions for SAR tests; Hotspot mode						
Antennas	**Front**	**Back**	**Top Side**	**Bottom Side**	**Left Side**	**Right Side**
WLAN	Yes	Yes	Yes	No	Yes	No
WWAN/BT	Yes	Yes	Yes	No	No	No

General Note: Referring to KDB 941225 D06 v02, When the overall device length and width are ≥9cm*5cm, the test distance is 0mm, SAR must be measured for all sides and surfaces with a transmitting antenna located with 25mm from that surface or edge.

4.3. SAR Measurement Results

The calculated SAR is obtained by the following formula:

Reported SAR=Measured SAR*$10^{(Ptarget-Pmeasured))/10}$

Scaling factor=$10^{(Ptarget-Pmeasured))/10}$

Reported SAR= Measured SAR* Scaling factor

Where

P_{target} is the power of manufacturing upper limit;

$P_{measured}$ is the measured power;

Measured SAR is measured SAR at measured power which including power drift)

Reported SAR which including Power Drift and Scaling factor

Duty Cycle

Test Mode	Duty Cycle
GSM	1:2.67
UMTS	1:1
LTE	1:1
WLAN2450	1:1

4.3.1 SAR Results

SAR Values [GSM 850]

Ch.	*Freq. (MHz)*	*Time slots*	*Test Position*	*Conducted Power (dBm)*	*Maximum Allowed Power (dBm)*	*Power Drift (%)*	*Scaling Factor*	*SAR_{1-g} results(W/kg)*		*Graph Results*
								Measured	*Reported*	
measured / reported SAR numbers - Body (hotspot open, distance 0mm)										
190	836.6	3Txslots	Front	29.53	30.00	-3.44	1.114	0.298	0.332	
190	836.6	3Txslots	Rear	29.53	30.00	0.07	1.114	**0.362**	**0.403**	**Plot 1**
190	836.6	3Txslots	Left	29.53	30.00	-2.89	1.114	0.274	0.305	
190	836.6	3Txslots	Top	29.53	30.00	3.78	1.114	0.260	0.290	

Remark:

1. The value with blue color is the maximum SAR Value of each test band.

2. The frame average of GPRS (4Tx slots) higher than GSM and sample can support VoIP function, tested at GPRS (4Tx slots) mode for head.

3. Per FCC KDB Publication 447498 D01, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is optional for such test configuration(s).

SAR Values [GSM 1900]

Ch.	*Freq. (MHz)*	*time slots*	*Test Position*	*Conducted Power (dBm)*	*Maximum Allowed Power (dBm)*	*Power Drift (%)*	*Scaling Factor*	*SAR_{1-g} results(W/kg)*		*Graph Results*
								Measured	*Reported*	
measured / reported SAR numbers – Body (hotspot open, distance 0mm)										
661	1880.0	3Txslots	Front	26.51	27.00	4.63	1.119	0.124	0.139	
661	1880.0	3Txslots	Rear	26.51	27.00	1.86	1.119	**0.213**	**0.238**	**Plot 2**
661	1880.0	3Txslots	Left	26.51	27.00	-2.87	1.119	0.115	0.129	
661	1880.0	3Txslots	Top	26.51	27.00	4.62	1.119	0.098	0.110	

Remark:

1. The value with blue color is the maximum SAR Value of each test band.

2. The frame average of GPRS (4Tx slots) higher than GSM and sample can support VoIP function, tested at GPRS (4Tx slots) mode for head.

3. Per FCC KDB Publication 447498 D01, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is optional for such test configuration(s).

SAR Values [WCDMA Band V]

Ch.	Freq. (MHz)	Channel Type	Test Position	Conducted Power (dBm)	Maximum Allowed Power (dBm)	Power Drift (%)	Scaling Factor	SAR_{1-g} results(W/kg)		Graph Results
								Measured	Reported	
measured / reported SAR numbers - Body (hotspot open, distance 0mm)										
4233	846.6	RMC*	Front	23.51	24.00	-4.65	1.119	0.085	0.095	
4233	846.6	RMC*	Rear	23.51	24.00	-2.69	1.119	**0.162**	**0.181**	**Plot 3**
4233	846.6	RMC*	Left	23.51	24.00	-1.10	1.119	0.078	0.087	
4233	846.6	RMC*	Top	23.51	24.00	3.23	1.119	0.063	0.071	

Remark:
1. The value with blue color is the maximum SAR Value of each test band.
2. Per FCC KDB Publication 447498 D01, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is optional for such test configuration(s).
3. RMC - RMC 12.2kbps mode;*

SAR Values [WCDMA Band II]

Ch.	Freq. (MHz)	Channel Type	Test Position	Conducted Power (dBm)	Maximum Allowed Power (dBm)	Power Drift (%)	Scaling Factor	SAR_{1-g} results(W/kg)		Graph Results
								Measured	Reported	
measured / reported SAR numbers - Body (hotspot open, distance 0mm)										
9538	1907.6	RMC	Front	23.62	24.00	-4.78	1.091	0.565	0.617	
9538	1907.6	RMC	Rear	23.62	24.00	-1.26	1.091	**0.722**	**0.788**	**Plot 4**
9538	1907.6	RMC	Left	23.62	24.00	2.64	1.091	0.550	0.600	
9538	1907.6	RMC	Top	23.62	24.00	-2.09	1.091	0.534	0.583	

Remark:
1. The value with blue color is the maximum SAR Value of each test band.
2. Per FCC KDB Publication 447498 D01, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is optional for such test configuration(s).
3. RMC - RMC 12.2kbps mode;*

SAR Values [LTE Band 2]

Ch.	Freq. (MHz)	Channel Type (20M)	Test Position	Conducted Power (dBm)	Maximum Allowed Power (dBm)	Power Drift (%)	Scaling Factor	SAR_{1-g} results(W/kg)		Graph Results
								Measured	Reported	
measured / reported SAR numbers - Body (hotspot open, distance 0mm)										
18700	1860.0	1RB	Front	21.69	22.00	-4.54	1.074	0.310	0.333	
18700	1860.0	1RB	Rear	21.69	22.00	-0.71	1.074	**0.440**	**0.473**	**Plot 5**
18700	1860.0	1RB	Left	21.69	22.00	3.12	1.074	0.294	0.316	
18700	1860.0	1RB	Top	21.69	22.00	0.65	1.074	0.281	0.302	
18700	1860.0	50%RB	Front	20.55	21.00	-2.20	1.109	0.156	0.173	
18700	1860.0	50%RB	Rear	20.55	21.00	0.67	1.109	0.224	0.248	
18700	1860.0	50%RB	Left	20.55	21.00	0.36	1.109	0.139	0.154	
18700	1860.0	50%RB	Top	20.55	21.00	-4.65	1.109	0.122	0.135	

SAR Values [LTE Band 5]

Ch.	Freq. (MHz)	Channel Type (20M)	Test Position	Conducted Power (dBm)	Maximum Allowed Power (dBm)	Power Drift (%)	Scaling Factor	SAR_{1-g} results(W/kg) Measured	SAR_{1-g} results(W/kg) Reported	Graph Results
measured / reported SAR numbers - Body (hotspot open, distance 0mm)										
20407	829.0	1RB	Front	22.63	23.00	4.75	1.089	0.075	0.082	
20407	829.0	1RB	Rear	22.63	23.00	0.35	1.089	**0.132**	**0.144**	**Plot 6**
20407	829.0	1RB	Left	22.63	23.00	-3.78	1.089	0.066	0.072	
20407	829.0	1RB	Top	22.63	23.00	0.98	1.089	0.059	0.064	
20525	836.5	50%RB	Front	21.71	22.00	-4.20	1.069	0.040	0.043	
20525	836.5	50%RB	Rear	21.71	22.00	-3.89	1.069	0.067	0.072	
20525	836.5	50%RB	Left	21.71	22.00	2.78	1.069	0.033	0.035	
20525	836.5	50%RB	Top	21.71	22.00	0.03	1.069	0.026	0.028	

SAR Values [LTE Band 7]

Ch.	Freq. (MHz)	Channel Type (20M)	Test Position	Conducted Power (dBm)	Maximum Allowed Power (dBm)	Power Drift (%)	Scaling Factor	SAR_{1-g} results(W/kg) Measured	SAR_{1-g} results(W/kg) Reported	Graph Results
measured / reported SAR numbers - Body (hotspot open, distance 0mm)										
21100	2535.0	1RB	Front	20.87	21.00	-3.33	1.030	0.226	0.233	
21100	2535.0	1RB	Rear	20.87	21.00	1.70	1.030	**0.315**	**0.325**	**Plot 7**
21100	2535.0	1RB	Left	20.87	21.00	-4.45	1.030	0.213	0.219	
21100	2535.0	1RB	Top	20.87	21.00	3.96	1.030	0.197	0.203	
21350	2560.0	50%RB	Front	19.58	20.00	2.89	1.102	0.115	0.127	
21350	2560.0	50%RB	Rear	19.58	20.00	-1.02	1.102	0.163	0.180	
21350	2560.0	50%RB	Left	19.58	20.00	-2.97	1.102	0.104	0.115	
21350	2560.0	50%RB	Top	19.58	20.00	3.66	1.102	0.091	0.100	

SAR Values [LTE Band 38]

Ch.	Freq. (MHz)	Channel Type (20M)	Test Position	Conducted Power (dBm)	Maximum Allowed Power (dBm)	Power Drift (%)	Scaling Factor	SAR_{1-g} results(W/kg) Measured	SAR_{1-g} results(W/kg) Reported	Graph Results
measured / reported SAR numbers - Body (hotspot open, distance 0mm)										
38000	2595.0	1RB	Front	20.63	21.00	-4.21	1.089	0.145	0.158	
38000	2595.0	1RB	Rear	20.63	21.00	-0.69	1.089	**0.219**	**0.238**	**Plot 8**
38000	2595.0	1RB	Left	20.63	21.00	2.30	1.089	0.131	0.143	
38000	2595.0	1RB	Top	20.63	21.00	4.85	1.089	0.116	0.126	
37850	2580.0	50%RB	Front	19.98	20.00	-3.52	1.005	0.078	0.078	
37850	2580.0	50%RB	Rear	19.98	20.00	-1.09	1.005	0.110	0.111	
37850	2580.0	50%RB	Left	19.98	20.00	2.22	1.005	0.070	0.070	
37850	2580.0	50%RB	Top	19.98	20.00	3.72	1.005	0.063	0.063	

SAR Values [LTE Band 41]

Ch.	Freq. (MHz)	Channel Type (10M)	Test Position	Conducted Power (dBm)	Maximum Allowed Power (dBm)	Power Drift (%)	Scaling Factor	SAR1-g results(W/kg) Measured	SAR1-g results(W/kg) Reported	Graph Results
measured / reported SAR numbers - Body (hotspot open, distance 0mm)										
40620	2593.0	1RB	Front	20.52	21.00	-2.96	1.117	0.143	0.160	
40620	2593.0	1RB	Rear	20.52	21.00	-0.68	1.117	**0.172**	**0.192**	**Plot 9**
40620	2593.0	1RB	Left	20.52	21.00	1.11	1.117	0.122	0.136	
40620	2593.0	1RB	Top	20.52	21.00	-2.30	1.117	0.104	0.116	
40620	2593.0	50%RB	Front	20.04	20.50	4.97	1.112	0.072	0.080	
40620	2593.0	50%RB	Rear	20.04	20.50	0.98	1.112	0.095	0.106	
40620	2593.0	50%RB	Left	20.04	20.50	-1.98	1.112	0.063	0.070	
40620	2593.0	50%RB	Top	20.04	20.50	3.35	1.112	0.054	0.060	

SAR Values [WIFI2.4G]

Ch.	*Freq. (MHz)*	*Service*	*Test Position*	*Conducted Power (dBm)*	*Maximum Allowed Power (dBm)*	*Power Drift (%)*	*Scaling Factor*	*SAR1-g results(W/kg)*		*Graph Results*
								Measured	*Reported*	
measured / reported SAR numbers - Body (hotspot open, distance 0mm)										
1	2412	802.11b	Front	14.78	15.00	4.32	1.052	0.098	0.103	
1	2412	802.11b	Rear	14.78	15.00	-2.30	1.052	**0.145**	**0.153**	**Plot 10**
1	2412	802.11b	Top	14.78	15.00	-2.96	1.052	0.080	0.084	

Remark:
1. The value with blue color is the maximum SAR Value of each test band.
2. Per FCC KDB Publication 447498 D01, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is optional for such test configuration(s).
3. When the same maximum output power is specified for both bands, begin SAR measurement in U-NII-2A band by applying the OFDM SAR requirements.19 If the highest reported SAR for a test configuration is ≤ 1.2 W/kg, SAR is not required for U-NII-1 band for that configuration (802.11 mode and exposure condition); otherwise, each band is tested independently for SAR.
4. When different maximum output power is specified for the bands, begin SAR measurement in the band with higher specified maximum output power. The highest reported SAR for the tested configuration is adjusted by the ratio of lower to higher specified maximum output power for the two bands. When the adjusted SAR is ≤ 1.2 W/kg, SAR is not required for the band with lower maximum output power in that test configuration; otherwise, each band is tested independently for SAR.

4.3.2 Standalone SAR Test Exclusion Considerations and Estimated SAR

Per KDB447498 requires when the standalone SAR test exclusion of section 4.3.1 is applied to an antenna that transmits simultaneously with other antennas, the standalone SAR must be estimated according to the following to determine simultaneous transmission SAR test exclusion;

● (max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] • [√f(GHz)/x] W/kg for test separation distances ≤ 50 mm;

where x = 7.5 for 1-g SAR, and x = 18.75 for 10-g SAR.

● 0.4 W/kg for 1-g SAR and 1.0 W/kg for 10-g SAR, when the test separation distances is > 50 mm

Per FCC KD B447498 D01,simultaneous transmission SAR test exclusion may be applied when the sum of the 1-g SAR for all the transmitting antenna in a specific a physical test configuration is ≤1.6 W/Kg.When the sum is greater than the SAR limit,SAR test exclusion is determined by the SAR to peak location separation ratio.

$$\text{Ratio}=\frac{(SAR_1+SAR_2)^{1.5}}{(\text{peak location separation,mm})}<0.04$$

Estimated stand alone SAR					
Communication system	Frequency (MHz)	Configuration	Maximum Power (dBm)	Separation Distance (mm)	Estimated SAR_{1-g} (W/kg)
Bluetooth*	2450	Hotspot	2.5	5	0.074
Bluetooth*	2450	Body-worn	2.5	5	0.074
NFC	13.56	Hotspot	-42.4	5	0.000002512
NFC	13.56	Body-worn	-42.4	5	0.000002512

Remark:

1. *Bluetooth*/NFC- Including Lower power Bluetooth*
2. *Maximum average power including tune-up tolerance;*
3. *When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion*
4. *Body as body use distance is 10mm from manufacturer declaration of user manual*

4.4. Simultaneous TX SAR Considerations

4.4.1 Introduction

Simultaneous transmission SAR test exclusion is determined for each operating configuration and exposure condition according to the reported standalone SAR of each applicable simultaneous transmiting antenna.
The device has 4 antennas, WWAN main antenna, WWAN diversity antenna(RX only), and WiFi antenna supports 2.4Wi-Fi.The 2 TX antennas can always transmit simultaneously.The work mode combination is showed as below table.;

Application Simultaneous Transmission information:

Combination No.	Mode
1	WWAN+WIFI
2	WWAN+NFC
3	WIFI+NFC
4	BT+NFC

4.4.2 Evaluation of Simultaneous SAR

Body Hotspot Exposure Conditions

Simultaneous transmission SAR for WiFi and GSM

Test Position	GSM850 Reported SAR1-g (W/kg)	GSM1900 Reported SAR1-g (W/kg)	WiFi2.4G Reported SAR1-g (W/kg)	MAX. ΣSAR1-g (W/kg)	SAR1-g Limit (W/kg)	Peak location separation ratio	Simut Meas. Required
Front	**0.332**	0.139	**0.103**	0.435	1.6	no	no
Rear	**0.403**	0.238	**0.153**	**0.556**	1.6	no	no
Left	**0.305**	0.129	/	0.305	1.6	no	no

Right	/	/	/	/	1.6	no	no
Bottom	/	/	/	/	1.6	no	no
Top	**0.290**	0.110	**0.084**	0.374	1.6	no	no

Simultaneous transmission SAR for WiFi and UMTS

Test Position	UMTS Band V Reported SAR1-g (W/kg)	UMTS Band II Reported SAR1-g (W/kg)	WiFi2.4G Reported SAR1-g (W/kg)	MAX. ΣSAR1-g (W/kg)	SAR1-g Limit (W/kg)	Peak location separation ratio	Simut Meas. Required
Front	0.095	**0.617**	**0.103**	0.720	1.6	no	no
Rear	0.181	**0.788**	**0.153**	**0.941**	1.6	no	no
Left	0.087	**0.600**	/	0.600	1.6	no	no
Right	/	/	/	/	1.6	no	no
Bottom	/	/	/	/	1.6	no	no
Top	0.071	**0.583**	**0.084**	0.667	1.6	no	no

SAR for WiFi and LTE

Reported SAR1-g(W/kg)	Test Position					
	Front	Rear	Left	Right	Bottom	Top
LTE Band2	**0.333**	**0.473**	**0.316**	/	/	**0.302**
LTE Band5	0.082	0.144	0.072	/	/	0.064
LTE Band7	0.233	0.325	0.219	/	/	0.203
LTE Band38	0.158	0.238	0.143	/	/	0.126
LTE Band41	0.160	0.192	0.136	/	/	0.116
WiFi2.4G	**0.103**	**0.153**	/	/	/	**0.084**
MAX. ΣSAR1-g (W/kg)	0.436	**0.626**	0.316	/	/	0.386
SAR1-g Limit (W/kg)	1.6	1.6	1.6	1.6	1.6	1.6
Peak location separation ratio	no	no	no	no	no	no
Simut Meas. Required	no	no	no	no	no	no

Simultaneous transmission SAR for BT and GSM

Test Position	GSM850 Reported SAR1-g (W/kg)	GSM1900 Reported SAR1-g (W/kg)	BT Estimated SAR1-g (W/kg)	MAX. ΣSAR1-g (W/kg)	SAR1-g Limit (W/kg)	Peak location separation ratio	Simut Meas. Required
Front	**0.332**	0.139	0.074	0.406	1.6	no	no
Rear	**0.403**	0.238	0.074	**0.477**	1.6	no	no
Left	**0.305**	0.129	/	0.305	1.6	no	no
Right	/	/	/	/	1.6	no	no
Bottom	/	/	/	/	1.6	no	no
Top	**0.290**	0.110	0.074	0.364	1.6	no	no

Simultaneous transmission SAR for BT and UMTS

Test Position	UMTS Band V Reported SAR1-g (W/kg)	UMTS Band II Reported SAR1-g (W/kg)	BT Estimated SAR1-g (W/kg)	MAX. ΣSAR1-g (W/kg)	SAR1-g Limit (W/kg)	Peak location separation ratio	Simut Meas. Required
Front	0.095	**0.617**	**0.074**	0.691	1.6	no	no
Rear	0.181	**0.788**	**0.074**	**0.862**	1.6	no	no
Left	0.087	**0.600**	/	0.600	1.6	no	no
Right	/	/	/	/	1.6	no	no

Bottom	/	/	/	/	1.6	no	no
Top	0.071	**0.583**	**0.074**	0.657	1.6	no	no

SAR for BT and LTE

Reported SAR1-g(W/kg)	Test Position					
	Front	Rear	Left	Right	Bottom	Top
LTE Band2	**0.333**	**0.473**	**0.316**	/	/	**0.302**
LTE Band5	0.082	0.144	0.072	/	/	0.064
LTE Band7	0.233	0.325	0.219	/	/	0.203
LTE Band38	0.158	0.238	0.143	/	/	0.126
LTE Band41	0.160	0.192	0.136	/	/	0.116
BT Estimated SAR1-g (W/kg)	**0.074**	**0.074**	/	/	/	**0.074**
MAX. ΣSAR1-g (W/kg)	0.407	**0.547**	0.316	/	/	0.376
SAR1-g Limit (W/kg)	1.6	1.6	1.6	1.6	1.6	1.6
Peak location separation ratio	no	no	no	no	no	no
Simut Meas. Required	no	no	no	no	no	no

Simultaneous transmission SAR for NFC and GSM

Test Position	GSM850 Reported SAR1-g (W/kg)	GSM1900 Reported SAR1-g (W/kg)	NFC Reported SAR1-g (W/kg)	MAX. ΣSAR1-g (W/kg)	SAR1-g Limit (W/kg)	Peak location separation ratio	Simut Meas. Required
Front	**0.332**	0.139	**0.000002512**	0.332002512	1.6	no	no
Rear	**0.403**	0.238	**0.000002512**	**0.403002512**	1.6	no	no
Left	**0.305**	0.129	**0.000002512**	0.305002512	1.6	no	no
Right	/	/	**0.000002512**	0.000002512	1.6	no	no
Bottom	/	/	**0.000002512**	0.000002512	1.6	no	no
Top	**0.290**	0.110	**0.000002512**	0.290002512	1.6	no	no

Simultaneous transmission SAR for NFC and UMTS

Test Position	UMTS Band V Reported SAR1-g (W/kg)	UMTS Band II Reported SAR1-g (W/kg)	NFC Reported SAR1-g (W/kg)	MAX. ΣSAR1-g (W/kg)	SAR1-g Limit (W/kg)	Peak location separation ratio	Simut Meas. Required
Front	0.095	**0.617**	**0.000002512**	0.617002512	1.6	no	no
Rear	0.181	**0.788**	**0.000002512**	**0.788002512**	1.6	no	no
Left	0.087	**0.600**	**0.000002512**	0.600002512	1.6	no	no
Right	/	/	**0.000002512**	0.000002512	1.6	no	no
Bottom	/	/	**0.000002512**	0.000002512	1.6	no	no
Top	0.071	**0.583**	**0.000002512**	0.583002512	1.6	no	no

SAR for NFC and LTE

Reported SAR1-g(W/kg)	Test Position					
	Front	Rear	Left	Right	Bottom	Top
LTE Band2	**0.333**	**0.473**	**0.316**	/	/	**0.302**
LTE Band5	0.082	0.144	0.072	/	/	0.064
LTE Band7	0.233	0.325	0.219	/	/	0.203
LTE Band38	0.158	0.238	0.143	/	/	0.126
LTE Band41	0.160	0.192	0.136	/	/	0.116
NFC	**0.000002512**	**0.000002512**	**0.000002512**	**0.000002512**	**0.000002512**	**0.000002512**
MAX. ΣSAR1-g (W/kg)	0.333002512	**0.473002512**	0.316002512	0.000002512	0.000002512	0.302002512
SAR1-g Limit (W/kg)	1.6	1.6	1.6	1.6	1.6	1.6
Peak location separation ratio	no	no	no	no	no	no
Simut Meas. Required	no	no	no	no	no	no

Simultaneous transmission SAR for WiFi and NFC

Test Position	NFC Reported SAR1-g (W/kg)	WiFi2.4G Reported SAR1-g (W/kg)	MAX. ΣSAR1-g (W/kg)	SAR1-g Limit (W/kg)	Peak location separation ratio	Simut Meas. Required
Front	**0.000002512**	**0.103**	0.103002512	1.6	no	no
Rear	**0.000002512**	**0.153**	**0.153002512**	1.6	no	no
Left	**0.000002512**	/	0.000002512	1.6	no	no
Right	**0.000002512**	/	0.000002512	1.6	no	no
Bottom	**0.000002512**	/	0.000002512	1.6	no	no
Top	**0.000002512**	**0.084**	0.084002512	1.6	no	no

Simultaneous transmission SAR for BT and NFC

Test Position	NFC Reported SAR1-g (W/kg)	BT Estimated SAR1-g (W/kg)	MAX. ΣSAR1-g (W/kg)	SAR1-g Limit (W/kg)	Peak location separation ratio	Simut Meas. Required
Front	**0.000002512**	**0.074**	0.074002512	1.6	no	no
Rear	**0.000002512**	**0.074**	**0.074002512**	1.6	no	no
Left	**0.000002512**	/	0.000002512	1.6	no	no
Right	**0.000002512**	/	0.000002512	1.6	no	no
Bottom	**0.000002512**	/	0.000002512	1.6	no	no
Top	**0.000002512**	**0.074**	0.074002512	1.6	no	no

Note:
1. The WiFi and BT share same antenna, so cannot transmit at same time.
2. The value with **block** color is the maximum values of standalone
3. The value with blue color is the maximum values of $\sum SAR_{1\text{-}g}$

4.5. SAR Measurement Variability

According to KDB865664, Repeated measurements are required only when the measured SAR is ≥ 0.80 W/kg. If the measured SAR value of the initial repeated measurement is < 1.45 W/kg with ≤ 20% variation, only one repeated measurement is required to reaffirm that the results are not expected to have substantial variations, which may introduce significant compliance concerns. A second repeated measurement is required only if the measured result for the initial repeated measurement is within 10% of the SAR limit and vary by more than 20%, which are often related to device and measurement setup difficulties. The following procedures are applied to determine if repeated measurements are required. 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.19 The repeated measurement results must be clearly identified in the SAR report. All measured SAR, including the repeated results, must be considered to determine compliance and for reporting according to KDB 690783.Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg; steps 2) through 4) do not apply.

3) When the original highest measured SAR is ≥ 0.80 W/kg, repeat that measurement once.
4) 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).
5) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.
6) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20

Frequency Band (MHz)	Air Interface	RF Exposure Configuration	Test Position	Repeated SAR (yes/no)	Highest Measured SAR_{1-g} (W/Kg)	First Repeated	
						Measued SAR_{1-g} (W/Kg)	Largest to Smallest SAR Ratio
850	GSM 850	Standalone	Body- Rear	no	0.362	n/a	n/a
	WCDMA Band V	Standalone	Body- Rear	no	0.162	n/a	n/a
	LTE Band 5	Standalone	Body- Rear	no	0.132	n/a	n/a
1900	GSM 1900	Standalone	Body- Rear	no	0.213	n/a	n/a
	WCDMA Band II	Standalone	Body- Rear	no	0.722	n/a	n/a
	LTE Band 2	Standalone	Body- Rear	no	0.440	n/a	n/a
2450	2.4GWLAN	Standalone	Body- Rear	no	0.145	n/a	n/a
2600	LTE Band 7	Standalone	Body- Rear	no	0.315	n/a	n/a
	LTE Band 38	Standalone	Body- Rear	no	0.219	n/a	n/a
	LTE Band 41	Standalone	Body- Rear	no	0.172	n/a	n/a

Remark:

1. *Second Repeated Measurement is not required since the ratio of the largest to smallest SAR for the orignal and first repeated measurement is not > 1.20 or 3 (1-g or 10-g respectively)*

4.6. General description of test procedures

1. Test positions as described in the tables above are in accordance with the specified test standard.
2. Tests in body position were performed in that configuration, which generates the highest time based averaged output power (see conducted power results).
3. According to IEEE 1528 the SAR test shall be performed at middle channel. Testing of top and bottom channel is optional.
4. According to KDB 447498 D01 testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is:
   - ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
   - ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
   - ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz
5. IEEE 1528-2003 require the middle channel to be tested first. This generally applies to wireless devices that are designed to operate in technologies with tight tolerances for maximum output power variations across channels in the band. When the maximum output power variation across the required test channels is > ½ dB, instead of the middle channel, the highest output power channel must be used.
6. When the same maximum output power is specified for both bands, begin SAR measurement in U-NII-2A band by applying the OFDM SAR requirements.19 If the highest reported SAR for a test configuration is ≤ 1.2 W/kg, SAR is not required for U-NII-1 band for that configuration (802.11 mode and exposure condition); otherwise, each band is tested independently for SAR.
7. When different maximum output power is specified for the bands, begin SAR measurement in the band with higher specified maximum output power. The highest reported SAR for the tested configuration is adjusted by the ratio of lower to higher specified maximum output power for the two bands. When the adjusted SAR is ⩽ 1.2 W/kg, SAR is not required for the band with lower maximum output power in that test configuration; otherwise, each band is tested independently for SAR.

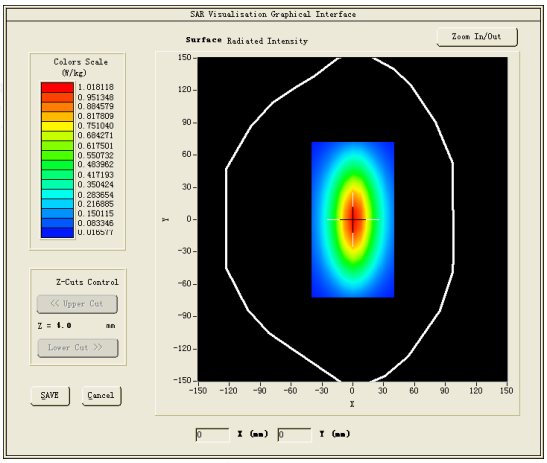
4.7. Measurement Uncertainty (450MHz-6GHz)

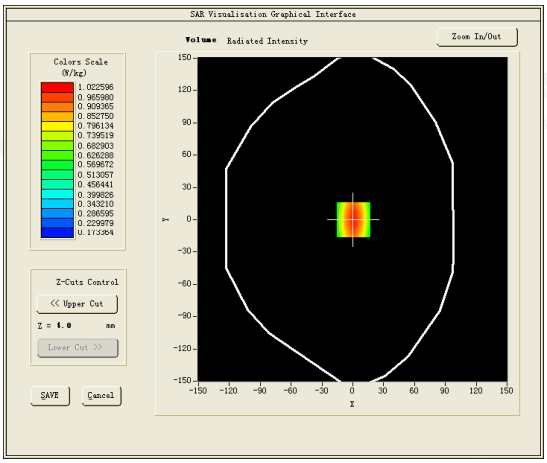
Not required as SAR measurement uncertainty analysis is required in SAR reports only when the highest measured SAR in a frequency band is ≥ 1.5 W/kg for 1-g SAR accoridng to KDB865664D01.

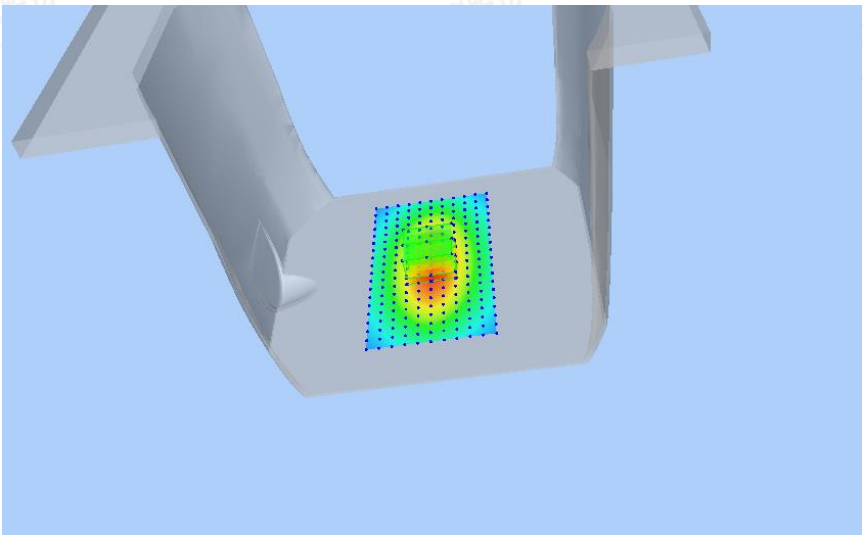
4.8. System Check Results

Test mode:835MHz(Head)
Product Description:Validation
Model:Dipole SID835
E-Field Probe:SSE2(SN 25/22 EPGO376)
Test Date: April 18, 2023

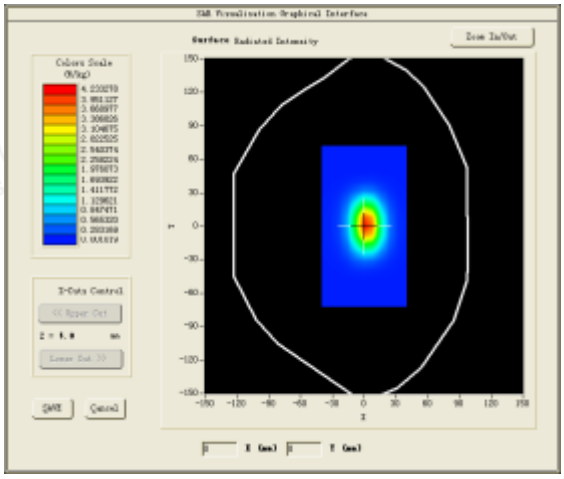
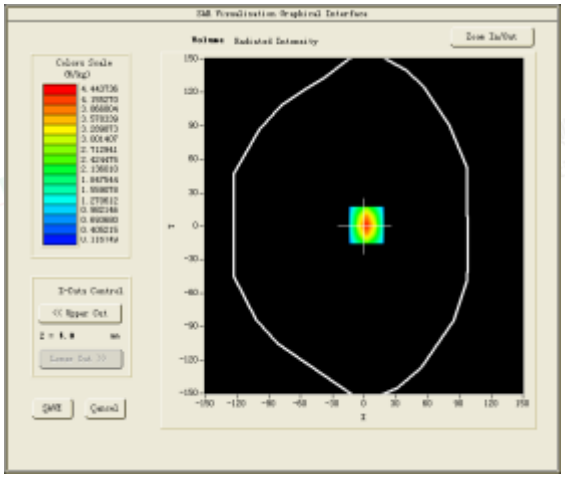
Medium(liquid type)	HSL_850
Frequency (MHz)	835.0000
Relative permittivity (real part)	42.98
Conductivity (S/m)	0.87
Input power	100mW
Crest Factor	1.0
Conversion Factor	1.75
Variation (%)	2.320000
SAR 10g (W/Kg)	0.643132
SAR 1g (W/Kg)	0.944488
SURFACE SAR	**VOLUME SAR**

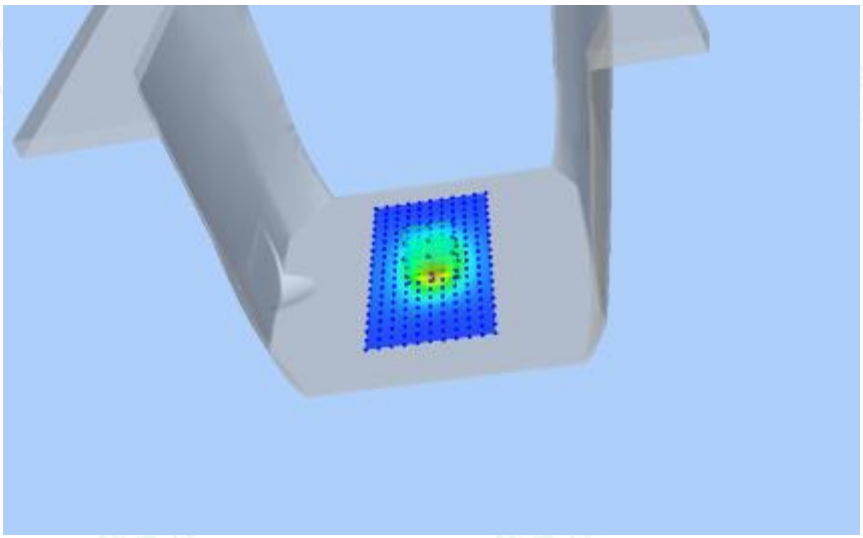






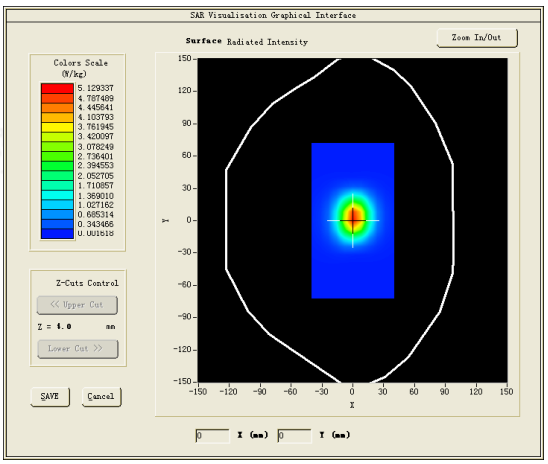
Test mode:1900MHz(Head)
Product Description:Validation
Model :Dipole SID1900
E-Field Probe:SSE2(SN 25/22 EPGO376)
Test Date: April 22, 2023

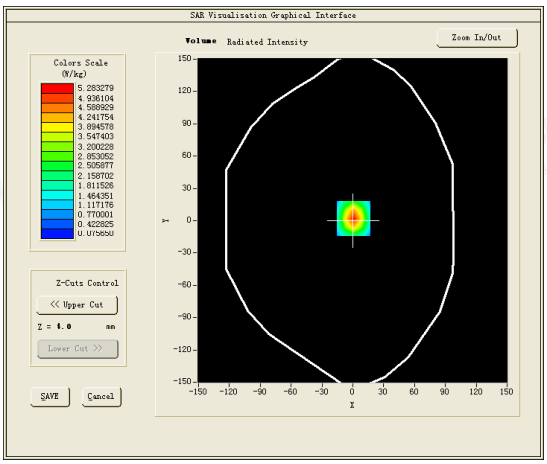
Medium(liquid type)	HSL_1900
Frequency (MHz)	1900.0000
Relative permittivity (real part)	38.42
Conductivity (S/m)	1.42
Input power	100mW
Crest Factor	1.0
Conversion Factor	2.14
Variation (%)	-1.280000
SAR 10g (W/Kg)	2.085260
SAR 1g (W/Kg)	3.920162
SURFACE SAR	**VOLUME SAR**
	

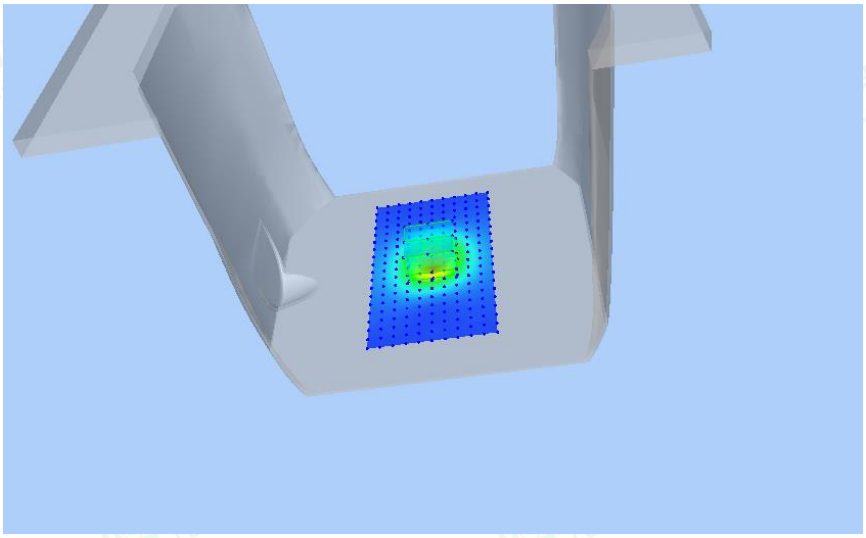


Test mode:2450MHz(Head)
Product Description:Validation
Model:Dipole SID2450
E-Field Probe:SSE2(SN 25/22 EPGO376)
Test Date: April 25, 2023

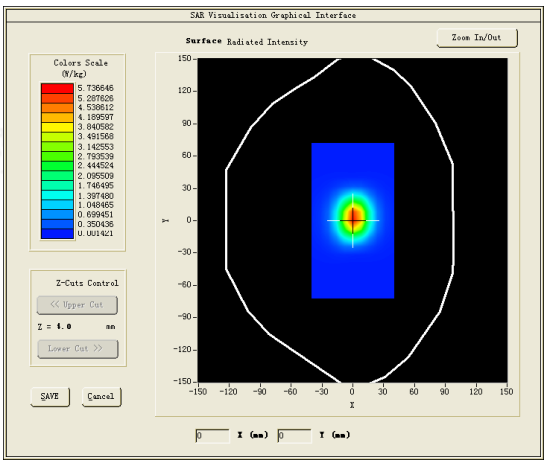
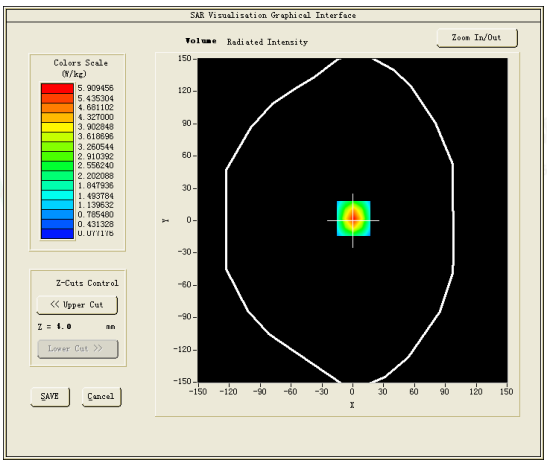
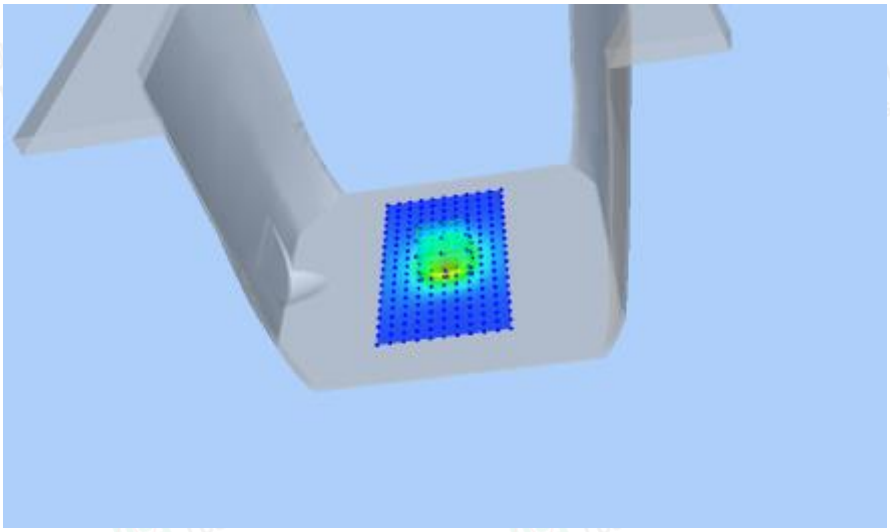
Medium(liquid type)	HSL_2450
Frequency (MHz)	2450.0000
Relative permittivity (real part)	39.66
Conductivity (S/m)	1.79
Input power	100mW
Crest Factor	1.0
Conversion Factor	2.60
Variation (%)	-0.320000
SAR 10g (W/Kg)	2.552463
SAR 1g (W/Kg)	5.466016
SURFACE SAR	**VOLUME SAR**







Test mode:2600MHz(Head)
Product Description:Validation
Model:Dipole SID2600
E-Field Probe: SSE2(SN 25/22 EPGO376)
Test Date: April 28, 2023

Medium(liquid type)	HSL_2600
Frequency (MHz)	2600.0000
Relative permittivity (real part)	38.13
Conductivity (S/m)	1.98
Input power	100mW
Crest Factor	1.0
Conversion Factor	2.39
Variation (%)	3.450000
SAR 10g (W/Kg)	2.298235
SAR 1g (W/Kg)	5.732023
SURFACE SAR	**VOLUME SAR**
	
	

4.9. SAR Test Graph Results

SAR plots for the highest measured SAR in each exposure configuration, wireless mode and frequency band combination

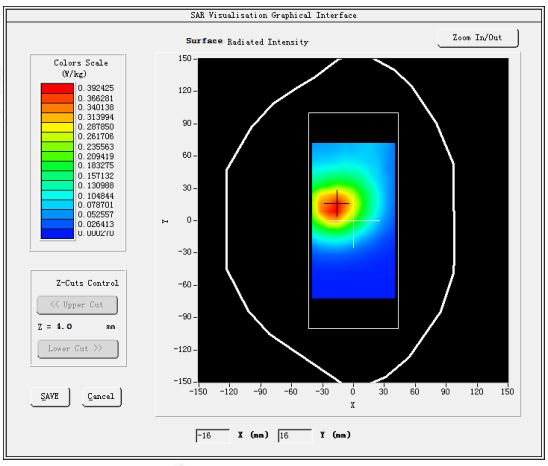
#1Test Mode: GSM850MHz, Middle channel(Body Rear Side)

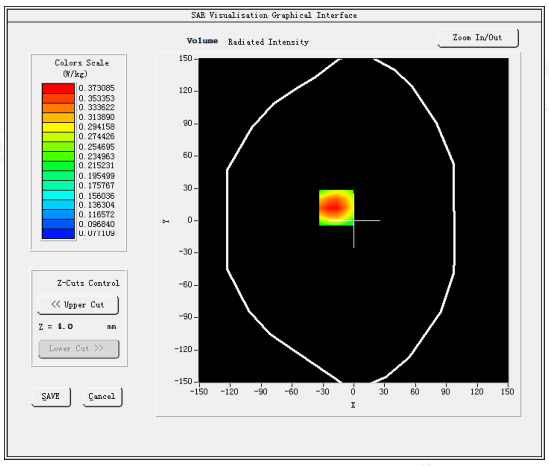
Product Description:Smart POS Terminal

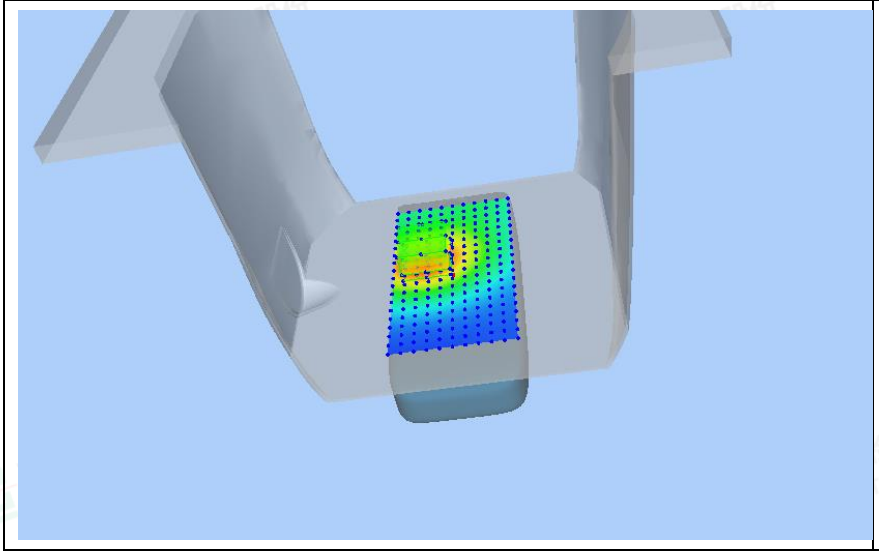
Model:P92

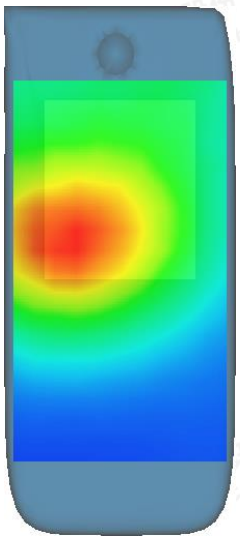
Test Date: April 18, 2023

Medium(liquid type)	HSL_850
Frequency (MHz)	836.6000
Relative permittivity (real part)	42.80
Conductivity (S/m)	0.89
E-Field Probe	SN 25/22 EPGO376
Crest Factor	2.0
Conversion Factor	1.75
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	0.070000
SAR 10g (W/Kg)	0.251283
SAR 1g (W/Kg)	0.361609
SURFACE SAR	VOLUME SAR





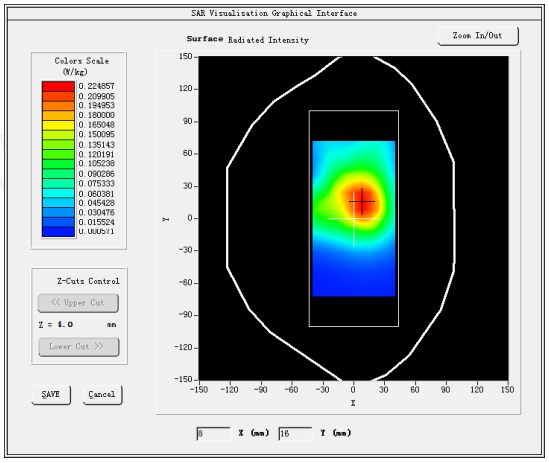


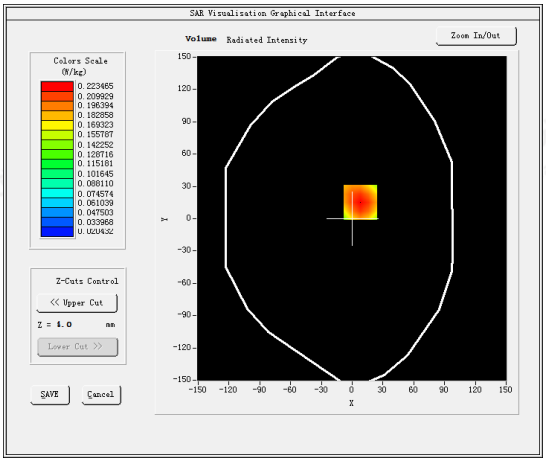


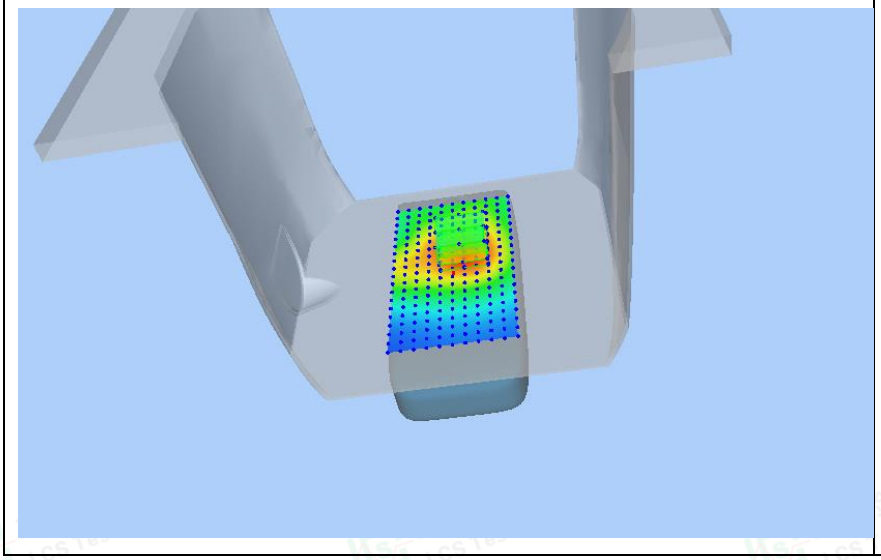
#2

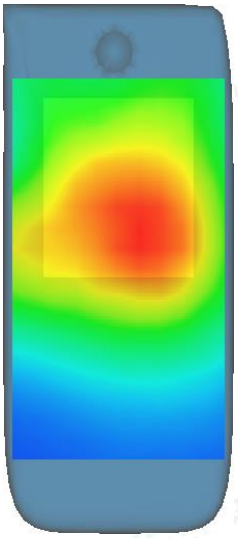
Test Mode: GPRS1900MHz, Middle channel(Body Rear Side)
Product Description:Smart POS Terminal
Model:P92
Test Date: April 22, 2023

Medium(liquid type)	HSL_1900
Frequency (MHz)	1880.0000
Relative permittivity (real part)	38.75
Conductivity (S/m)	1.40
E-Field Probe	SN 25/22 EPGO376
Crest Factor	2.0
Conversion Factor	2.14
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	1.860000
SAR 10g (W/Kg)	0.136860
SAR 1g (W/Kg)	0.213223
SURFACE SAR	**VOLUME SAR**





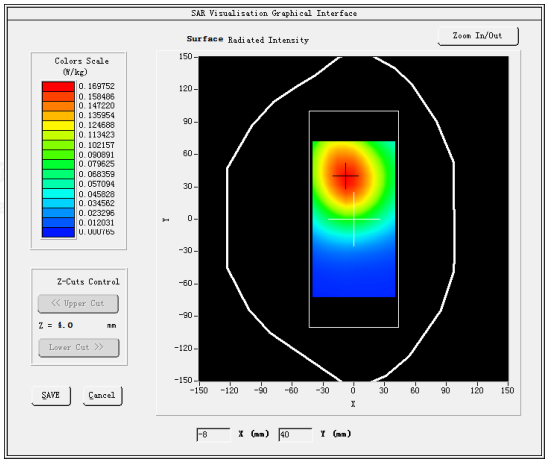


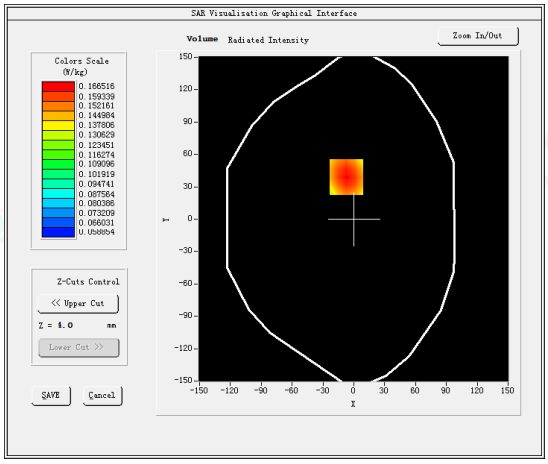


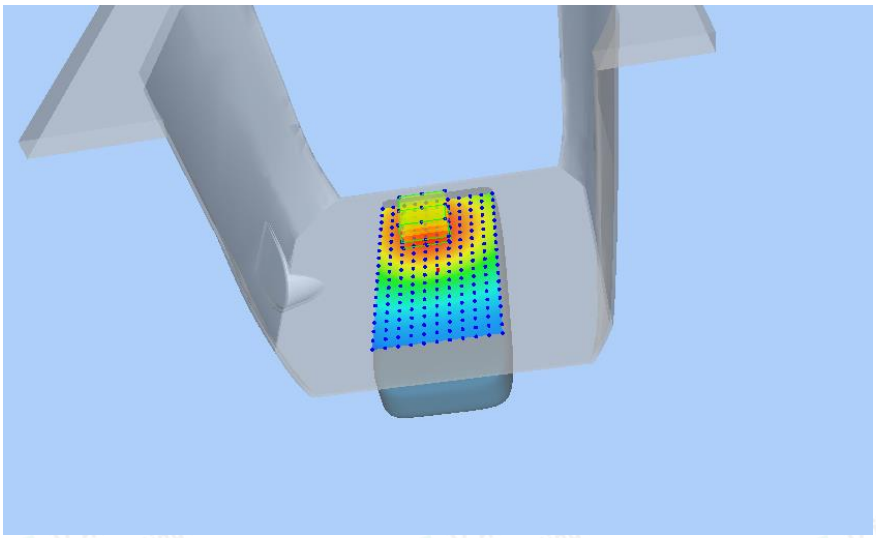
#3

Test Mode: WCDMA Band V, High channel(Body Rear Side)
Product Description:Smart POS Terminal
Model:P92
Test Date: April 18, 2023

Medium(liquid type)	HSL_850
Frequency (MHz)	846.6000
Relative permittivity (real part)	42.80
Conductivity (S/m)	0.89
E-Field Probe	SN 25/22 EPGO376
Crest Factor	1.0
Conversion Factor	1.75
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	-2.690000
SAR 10g (W/Kg)	0.127293
SAR 1g (W/Kg)	0.162340
SURFACE SAR	**VOLUME SAR**



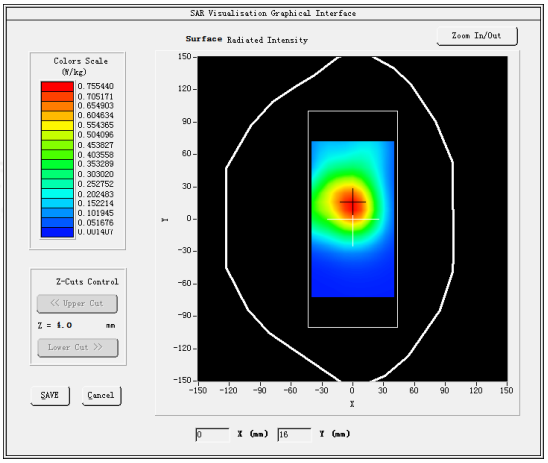


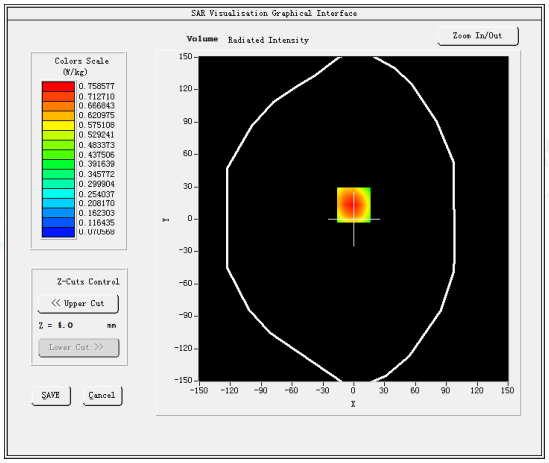


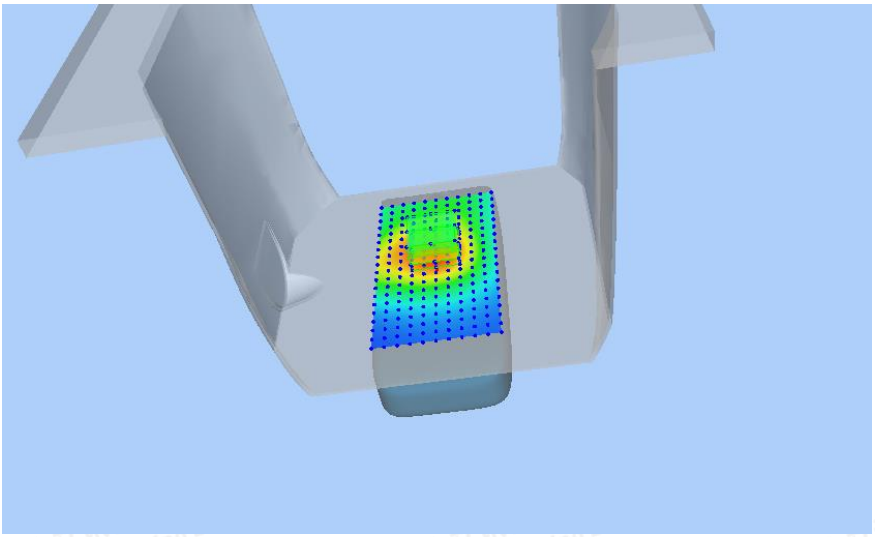
#4

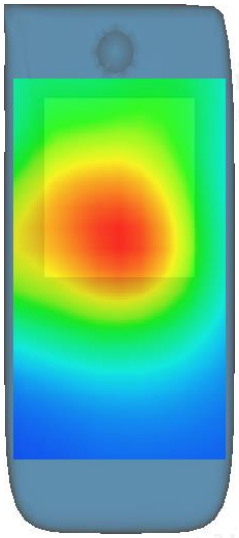
Test Mode: WCDMA Band II, High channel(Body Rear Side)
Product Description:Smart POS Terminal
Model:P92
Test Date: April 22, 2023

Medium(liquid type)	HSL_1900
Frequency (MHz)	1907.6000
Relative permittivity (real part)	38.75
Conductivity (S/m)	1.40
E-Field Probe	SN 25/22 EPGO376
Crest Factor	1.0
Conversion Factor	2.14
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	-1.260000
SAR 10g (W/Kg)	0.447328
SAR 1g (W/Kg)	0.722041
SURFACE SAR	**VOLUME SAR**





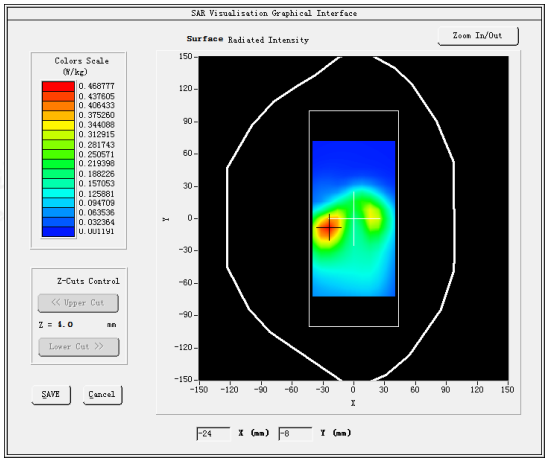


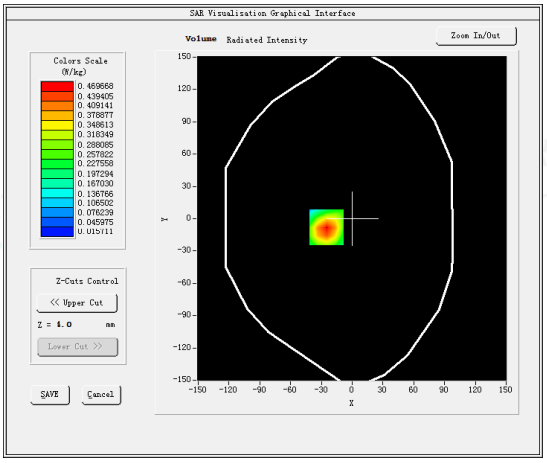


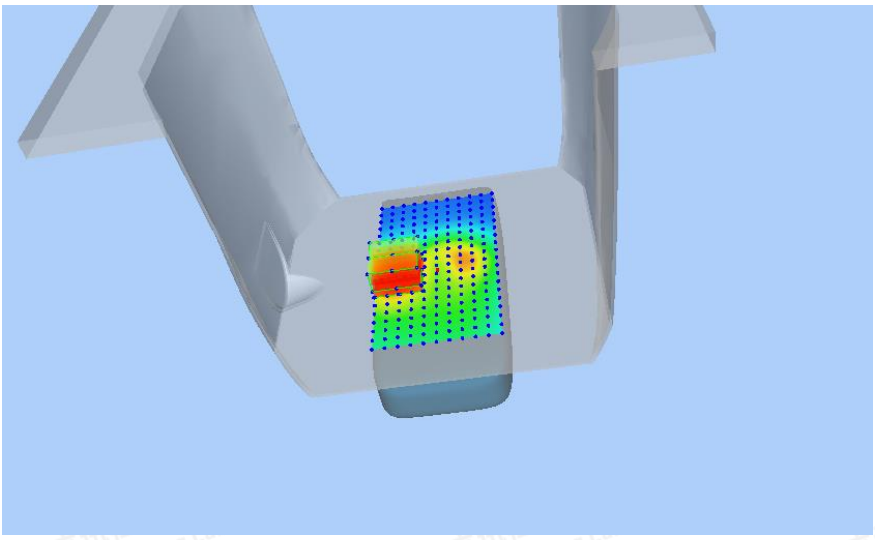
#5

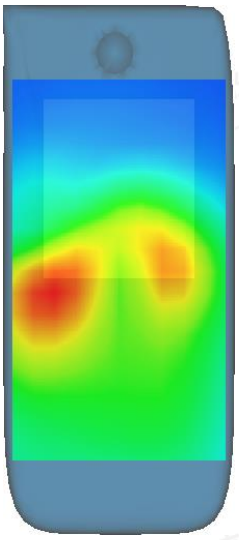
Test Mode: LTE Band 2, 1RB,Low channel(Body Rear Side)
Product Description:Smart POS Terminal
Model:P92
Test Date: April 22, 2023

Medium(liquid type)	HSL_1900
Frequency (MHz)	1860.0000
Relative permittivity (real part)	38.75
Conductivity (S/m)	1.40
E-Field Probe	SN 25/22 EPGO376
Crest Factor	1.0
Conversion Factor	2.14
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	-0.710000
SAR 10g (W/Kg)	0.249896
SAR 1g (W/Kg)	0.439735
SURFACE SAR	**VOLUME SAR**





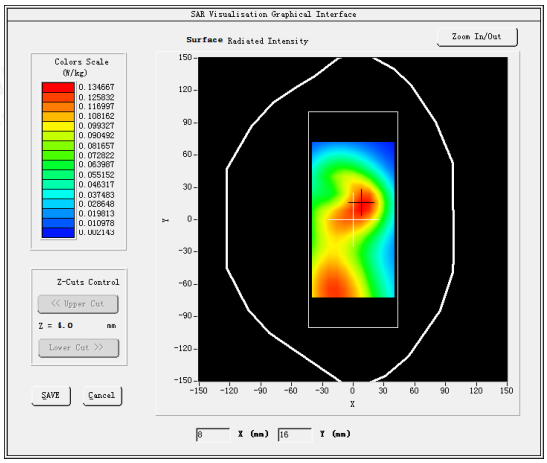


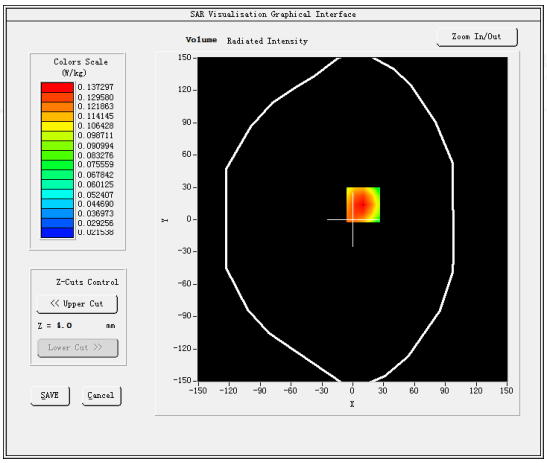


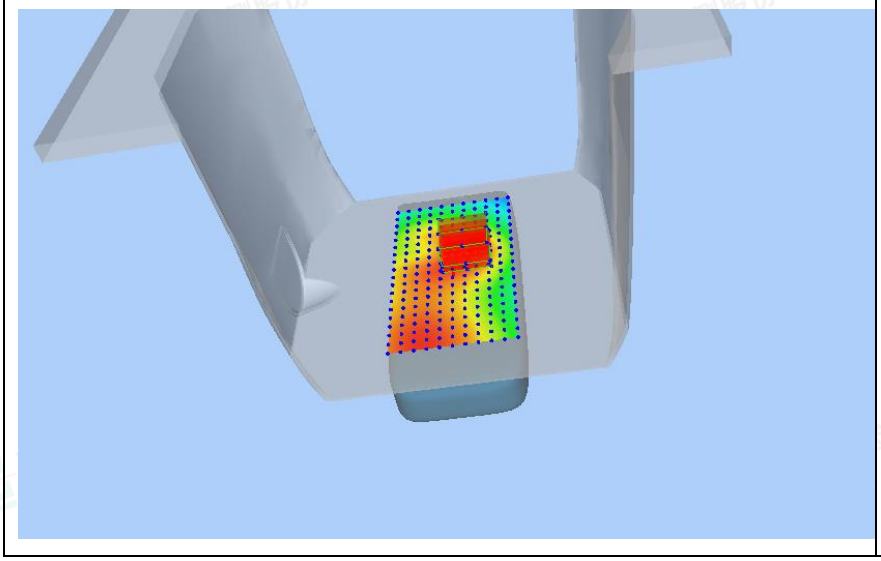
#6

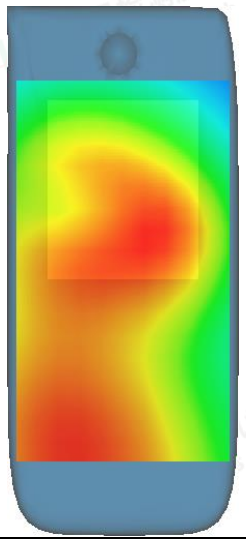
Test Mode: LTE Band 5, 1RB,Low channel(Body Rear Side)
Product Description:Smart POS Terminal
Model:P92
Test Date: April 18, 2023

Medium(liquid type)	HSL_850
Frequency (MHz)	829.0000
Relative permittivity (real part)	42.80
Conductivity (S/m)	0.89
E-Field Probe	SN 25/22 EPGO376
Crest Factor	1.0
Conversion Factor	1.75
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	0.350000
SAR 10g (W/Kg)	0.090879
SAR 1g (W/Kg)	0.132215
SURFACE SAR	**VOLUME SAR**





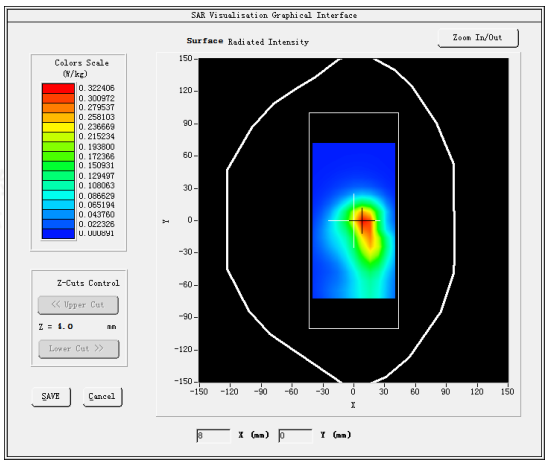


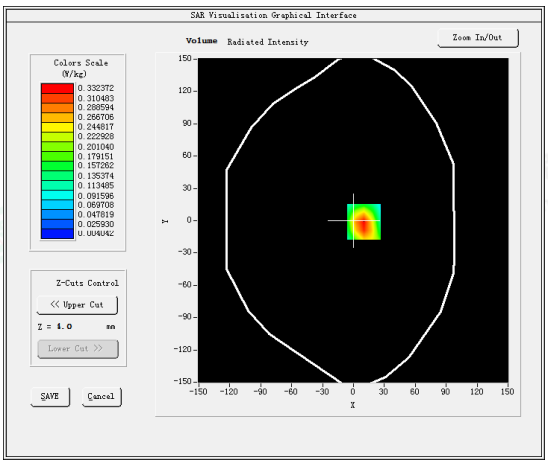


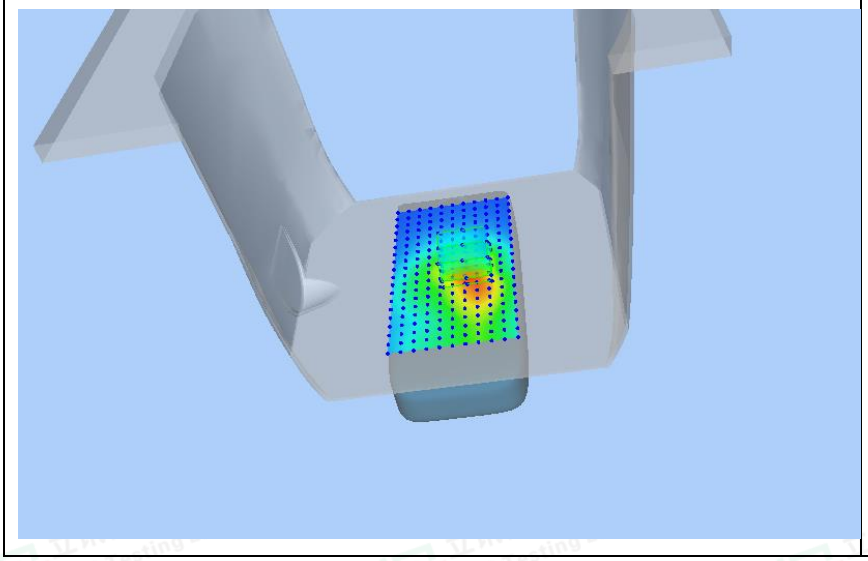
#7

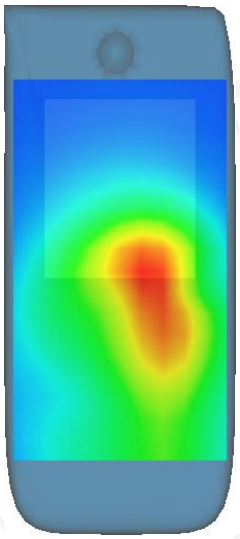
Test Mode: LTE Band 7, 1RB, Middle channel(Body Rear Side)
Product Description:Smart POS Terminal
Model:P92
Test Date: April 28, 2023

Medium(liquid type)	HSL _2600
Frequency (MHz)	2535.0000
Relative permittivity (real part)	38.54
Conductivity (S/m)	1.97
E-Field Probe	SN 25/22 EPGO376
Crest Factor	1.0
Conversion Factor	2.39
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	1.700000
SAR 10g (W/Kg)	0.151528
SAR 1g (W/Kg)	0.314917
SURFACE SAR	**VOLUME SAR**





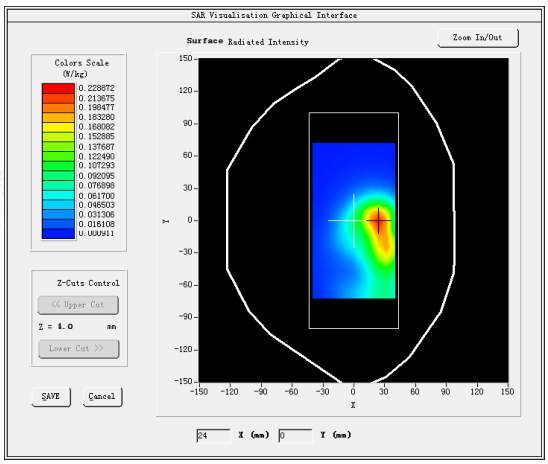


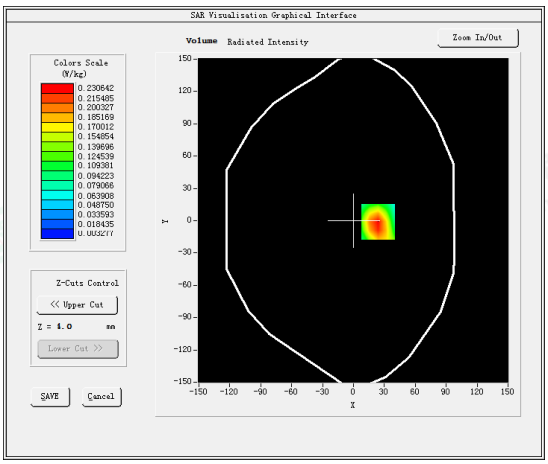


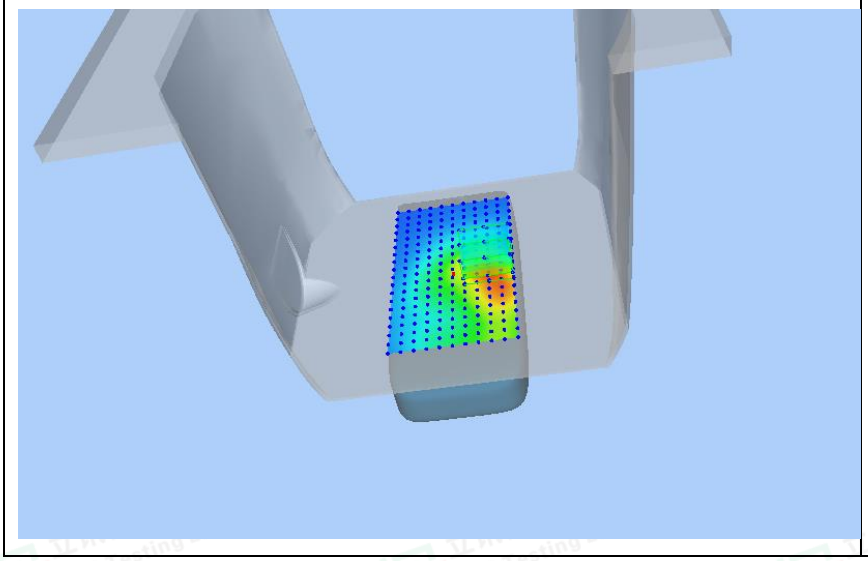
#8

Test Mode: LTE Band 38, 1RB, Middle channel(Body Rear Side)
Product Description:Smart POS Terminal
Model:P92
Test Date: April 28, 2023

Medium(liquid type)	HSL_2600
Frequency (MHz)	2595.0000
Relative permittivity (real part)	38.54
Conductivity (S/m)	1.97
E-Field Probe	SN 25/22 EPGO376
Crest Factor	1.0
Conversion Factor	2.39
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	-0.690000
SAR 10g (W/Kg)	0.108328
SAR 1g (W/Kg)	0.219175
SURFACE SAR	**VOLUME SAR**



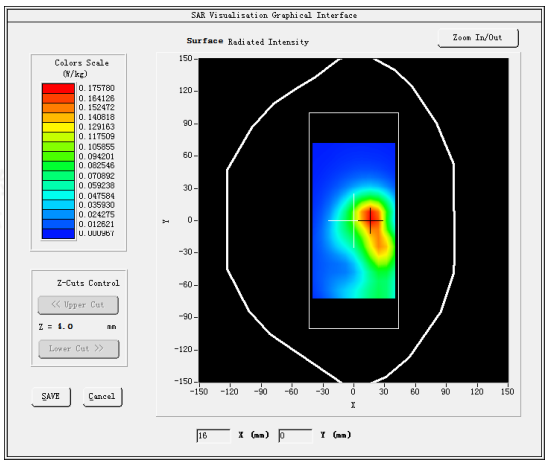


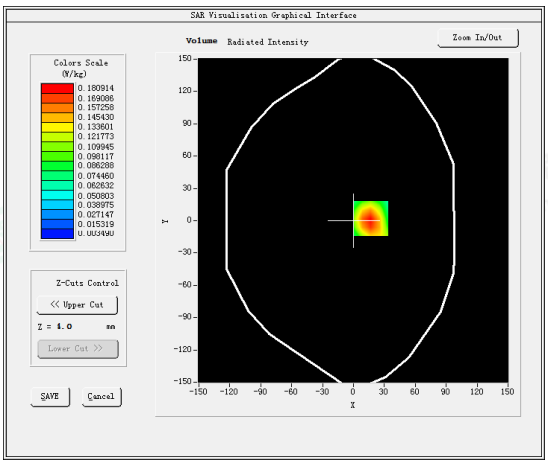


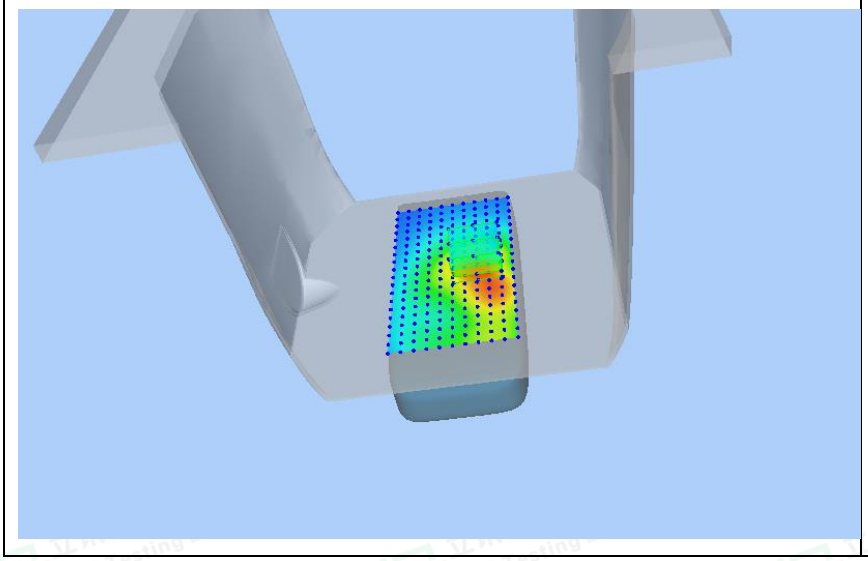
#9

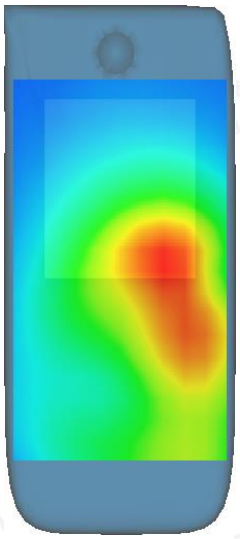
Test Mode: LTE Band 41, 1RB, Middle channel(Body Rear Side)
Product Description:Smart POS Terminal
Model:P92
Test Date: April 28, 2023

Medium(liquid type)	HSL_2600
Frequency (MHz)	2593.0000
Relative permittivity (real part)	38.54
Conductivity (S/m)	1.97
E-Field Probe	SN 25/22 EPGO376
Crest Factor	1.58
Conversion Factor	2.39
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	-0.680000
SAR 10g (W/Kg)	0.086982
SAR 1g (W/Kg)	0.171736
SURFACE SAR	**VOLUME SAR**





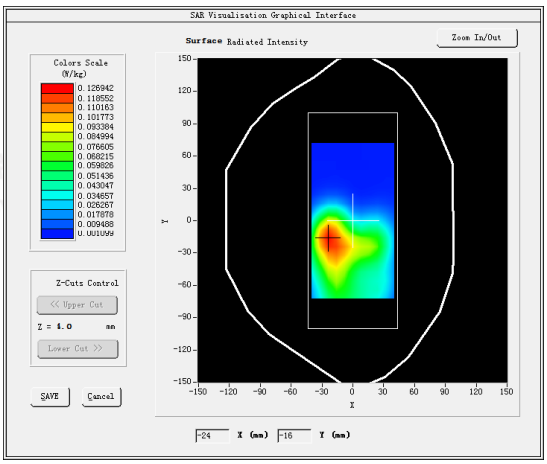


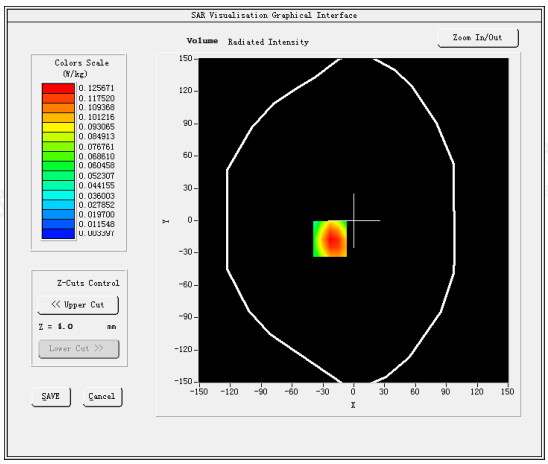


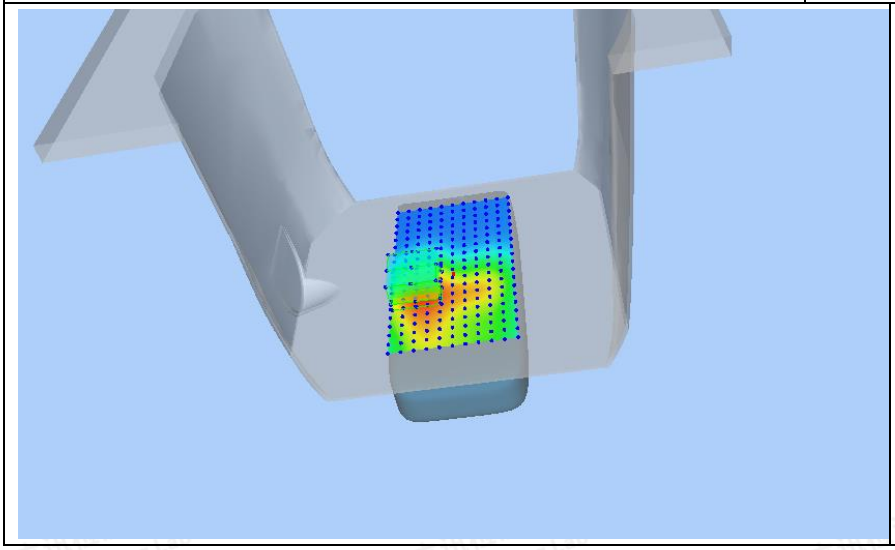
#10

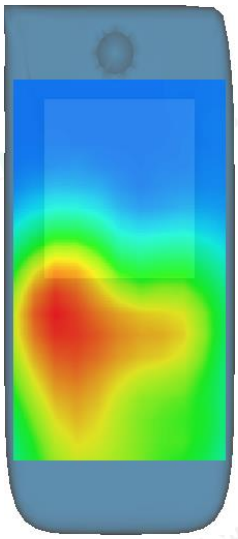
Test Mode: 802.11b (WiFi2.4G),Low channel(Body Rear Side)
Product Description:Smart POS Terminal
Model:P92
Test Date: April 25, 2023

Medium(liquid type)	HSL_2450
Frequency (MHz)	2412.0000
Relative permittivity (real part)	39.95
Conductivity (S/m)	1.77
E-Field Probe	SN 25/22 EPGO376
Crest Factor	1.0
Conversion Factor	2.60
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	-2.300000
SAR 10g (W/Kg)	0.072147
SAR 1g (W/Kg)	0.145036
SURFACE SAR	**VOLUME SAR**









5. CALIBRATION CERTIFICATES

5.1 Probe-EPGO376 Calibration Certificate

COMOSAR E-Field Probe Calibration Report

Ref : ACR.180.4.22.BES.A

SHENZHEN LCS COMPLIANCE TESTING LABORATORY LTD.

1F., XINGYUAN INDUSTRIAL PARK, TONGDA ROAD, BAO'AN BLVD

BAO'AN DISTRICT, SHENZHEN, GUANGDONG, CHINA

MVG COMOSAR DOSIMETRIC E-FIELD PROBE

SERIAL NO.: SN 25/22 EPGO376

Calibrated at MVG

Z.I. de la pointe du diable

Technopôle Brest Iroise – 295 avenue Alexis de Rochon

29280 PLOUZANE - FRANCE

Calibration date: 06/29/2022

Accreditations #2-6789
Scope available on www.cofrac.fr

The use of the Cofrac brand and the accreditation references is prohibited from any reproduction.

Summary:

This document presents the method and results from an accredited COMOSAR Dosimetric E-Field Probe calibration performed at MVG, using the CALIPROBE test bench, for use with a MVG COMOSAR system only. The test results covered by accreditation are traceable to the International System of Units (SI).

Page: 1/11

COMOSAR E-FIELD PROBE CALIBRATION REPORT Ref: ACR.180.4.22.BES.A

	Name	*Function*	*Date*	*Signature*
Prepared by :	Jérôme Le Gall	Measurement Responsible	6/30/2022	
Checked & approved by:	Jérôme Luc	Technical Manager	6/30/2022	
Authorized by:	Yann Toutain	Laboratory Director	6/30/2022	Yann TOUTAIN

2022.06.30
13:37:53 +02'00'

	Customer Name
Distribution :	Shenzhen LCS Compliance Testing Laboratory Ltd.

Issue	*Name*	*Date*	*Modifications*
A	Jérôme Le Gall	6/30/2022	Initial release

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1 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR DOSIMETRIC E FIELD PROBE
Manufacturer	MVG
Model	SSE2
Serial Number	SN 25/22 EPGO376
Product Condition (new / used)	New
Frequency Range of Probe	0.15 GHz-6GHz
Resistance of Three Dipoles at Connector	Dipole 1: R1=0.193 MΩ Dipole 2: R2=0.188 MΩ Dipole 3: R3=0.198 MΩ

2 PRODUCT DESCRIPTION

2.1 GENERAL INFORMATION

MVG's COMOSAR E field Probes are built in accordance to the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards.

Figure 1 – *MVG COMOSAR Dosimetric E field Probe*

Probe Length	330 mm
Length of Individual Dipoles	2 mm
Maximum external diameter	8 mm
Probe Tip External Diameter	2.5 mm
Distance between dipoles / probe extremity	1 mm

3 MEASUREMENT METHOD

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards provide recommended practices for the probe calibrations, including the performance characteristics of interest and methods by which to assess their affect. All calibrations / measurements performed meet the fore mentioned standards.

3.1 LINEARITY

The evaluation of the linearity was done in free space using the waveguide, performing a power sweep to cover the SAR range 0.01W/kg to 100W/kg.

3.2 SENSITIVITY

The sensitivity factors of the three dipoles were determined using a two step calibration method (air and tissue simulating liquid) using waveguides as outlined in the standards.

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3.3 LOWER DETECTION LIMIT

The lower detection limit was assessed using the same measurement set up as used for the linearity measurement. The required lower detection limit is 10 mW/kg.

3.4 ISOTROPY

The axial isotropy was evaluated by exposing the probe to a reference wave from a standard dipole with the dipole mounted under the flat phantom in the test configuration suggested for system validations and checks. The probe was rotated along its main axis from 0 to 360 degrees in 15-degree steps. The hemispherical isotropy is determined by inserting the probe in a thin plastic box filled with tissue-equivalent liquid, with the plastic box illuminated with the fields from a half wave dipole. The dipole is rotated about its axis (0°–180°) in 15° increments. At each step the probe is rotated about its axis (0°–360°).

3.1 BOUNDARY EFFECT

The boundary effect is defined as the deviation between the SAR measured data and the expected exponential decay in the liquid when the probe is oriented normal to the interface. To evaluate this effect, the liquid filled flat phantom is exposed to fields from either a reference dipole or waveguide. With the probe normal to the phantom surface, the peak spatial average SAR is measured and compared to the analytical value at the surface.

The boundary effect uncertainty can be estimated according to the following uncertainty approximation formula based on linear and exponential extrapolations between the surface and d_{be} + d_{step} along lines that are approximately normal to the surface:

$$\mathrm{SAR}_{\mathrm{uncertainty}}[\%] = \delta\mathrm{SAR}_{be}\,\frac{(d_{be}+d_{step})^2}{2d_{step}}\,\frac{\left(e^{-d_{be}/(\delta\beta)}\right)}{\delta/2} \quad \text{for } (d_{be}+d_{step}) < 10\text{ mm}$$

where

$\mathrm{SAR}_{\mathrm{uncertainty}}$	is the uncertainty in percent of the probe boundary effect
d_{be}	is the distance between the surface and the closest *zoom-scan* measurement point, in millimetre
Δ_{step}	is the separation distance between the first and second measurement points that are closest to the phantom surface, in millimetre, assuming the boundary effect at the second location is negligible
δ	is the minimum penetration depth in millimetres of the head tissue-equivalent liquids defined in this standard, i.e., $\delta \approx 14$ mm at 3 GHz;
$\Delta\mathrm{SAR}_{be}$	in percent of SAR is the deviation between the measured SAR value, at the distance d_{be} from the boundary, and the analytical SAR value.

The measured worst case boundary effect SAR uncertainty[%] for scanning distances larger than 4mm is 1.0% Limit ,2%).

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Shenzhen LCS Compliance Testing Laboratory Ltd.
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Tel: +(86) 0755-82591330 | E-mail: webmaster@lcs-cert.com | Web: www.lcs-cert.com
Scan code to check authenticity

4 MEASUREMENT UNCERTAINTY

The guidelines outlined in the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards were followed to generate the measurement uncertainty associated with an E-field probe calibration using the waveguide technique. All uncertainties listed below represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2, traceable to the Internationally Accepted Guides to Measurement Uncertainty.

Uncertainty analysis of the probe calibration in waveguide					
ERROR SOURCES	**Uncertainty value (%)**	**Probability Distribution**	**Divisor**	**ci**	**Standard Uncertainty (%)**
Expanded uncertainty 95 % confidence level k = 2					14 %

5 CALIBRATION MEASUREMENT RESULTS

Calibration Parameters	
Liquid Temperature	20 +/- 1 °C
Lab Temperature	20 +/- 1 °C
Lab Humidity	30-70 %

5.1 SENSITIVITY IN AIR

Normx dipole 1 (µV/(V/m)²)	Normy dipole 2 (µV/(V/m)²)	Normz dipole 3 (µV/(V/m)²)
0.76	0.78	0.76

DCP dipole 1 (mV)	DCP dipole 2 (mV)	DCP dipole 3 (mV)
106	107	108

Calibration curves ei=f(V) (i=1,2,3) allow to obtain E-field value using the formula:

$$E = \sqrt{E_1^2 + E_2^2 + E_3^2}$$

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Tel: +(86) 0755-82591330 | E-mail: webmaster@lcs-cert.com | Web: www.lcs-cert.com
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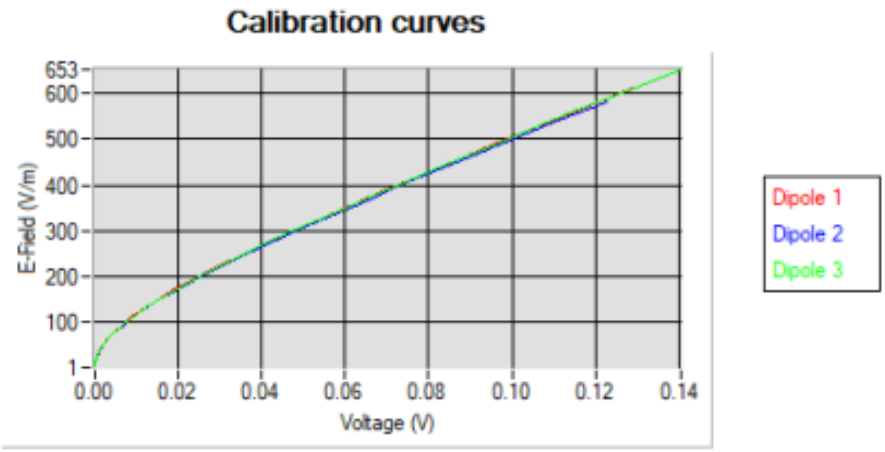
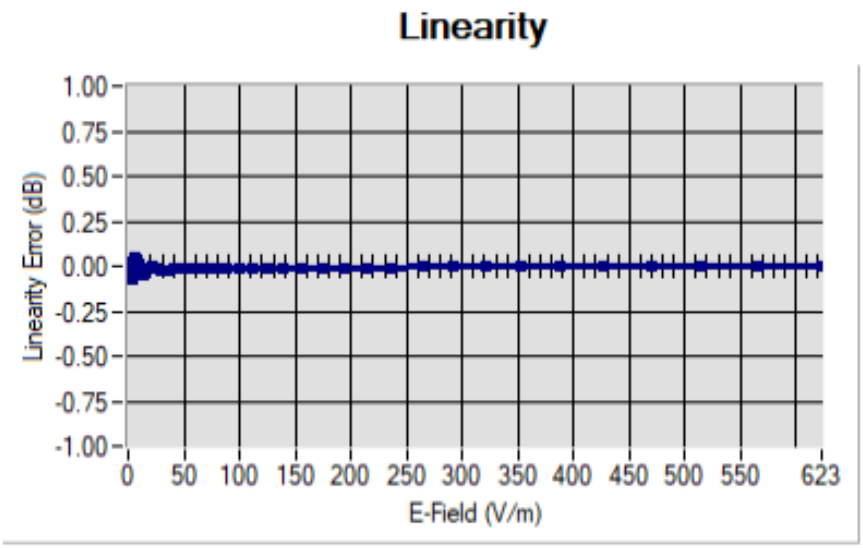


5.2 LINEARITY



Linearity:+/-1.81% (+/-0.08dB)

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5.3 SENSITIVITY IN LIQUID

Liquid	Frequency (MHz +/- 100MHz)	ConvF
HL450*	450*	1.74*
BL450*	450*	1.67*
HL750	750	1.69
BL750	750	1.73
HL850	835	1.75
BL850	835	1.80
HL900	900	1.87
BL900	900	1.85
HL1800	1800	2.09
BL1800	1800	2.15
HL1900	1900	2.14
BL1900	1900	2.27
HL2000	2000	2.31
BL2000	2000	2.34
HL2300	2300	2.46
BL2300	2300	2.51
HL2450	2450	2.60
BL2450	2450	2.70
HL2600	2600	2.39
BL2600	2600	2.50
HL5200	5200	1.85
BL5200	5200	1.81
HL5400	5400	2.07
BL5400	5400	2.00
HL5600	5600	2.19
BL5600	5600	2.11
HL5800	5800	2.01
BL5800	5800	1.97

* Frequency not cover by COFRAC scope, calibration not accredited

LOWER DETECTION LIMIT: 7mW/kg

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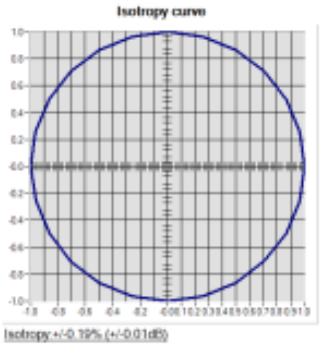
5.4 ISOTROPY

HL1800 MHz



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6 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	**Manufacturer / Model**	**Identification No.**	**Current Calibration Date**	**Next Calibration Date**
CALIPROBE Test Bench	Version 2	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rohde & Schwarz ZVM	100203	08/2021	08/2024
Network Analyzer	Agilent 8753ES	MY40003210	10/2019	10/2022
Network Analyzer – Calibration kit	HP 85033D	3423A08186	06/2021	06/2027
Multimeter	Keithley 2000	1160271	02/2020	02/2023
Signal Generator	Rohde & Schwarz SMB	106589	03/2022	03/2025
Amplifier	MVG	MODU-023-C-0002	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	NI-USB 5680	170100013	06/2021	06/2024
Power Meter	Rohde & Schwarz NRVD	832839-056	11/2019	11/2022
Directional Coupler	Krytar 158020	131467	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Waveguide	MVG	SN 32/16 WG4_1	Validated. No cal required.	Validated. No cal required.
Liquid transition	MVG	SN 32/16 WGLIQ_0G900_1	Validated. No cal required.	Validated. No cal required.
Waveguide	MVG	SN 32/16 WG6_1	Validated. No cal required.	Validated. No cal required.
Liquid transition	MVG	SN 32/16 WGLIQ_1G500_1	Validated. No cal required.	Validated. No cal required.
Waveguide	MVG	SN 32/16 WG8_1	Validated. No cal required.	Validated. No cal required.
Liquid transition	MVG	SN 32/16 WGLIQ_1G800B_1	Validated. No cal required.	Validated. No cal required.
Liquid transition	MVG	SN 32/16 WGLIQ_1G800H_1	Validated. No cal required.	Validated. No cal required.
Waveguide	MVG	SN 32/16 WG10_1	Validated. No cal required.	Validated. No cal required.
Liquid transition	MVG	SN 32/16 WGLIQ_3G500_1	Validated. No cal required.	Validated. No cal required.
Waveguide	MVG	SN 32/16 WG12_1	Validated. No cal required.	Validated. No cal required.

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Liquid transition	MVG	SN 32/16 WGLIQ_5G000_1	Validated. No cal required.	Validated. No cal required.
Temperature / Humidity Sensor	Testo 184 H1	44225320	06/2021	06/2024

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5.2 SID835Dipole Calibration Ceriticate

SATIMO
The microwave vision company

SAR Reference Dipole Calibration Report

Ref : ACR.287.4.14.SATU.A

SHENZHEN LCS COMPLIANCE TESTING LABORATORY LTD.
1F., XINGYUAN INDUSTRIAL PARK, TONGDA ROAD, BAO'AN BLVD
BAO'AN DISTRICT, SHENZHEN, GUANGDONG, CHINA
SATIMO COMOSAR REFERENCE DIPOLE
FREQUENCY: 835 MHZ
SERIAL NO.: SN 07/14 DIP 0G835-303

Calibrated at SATIMO US
2105 Barrett Park Dr. - Kennesaw, GA 30144

ilac-MRA
ACCREDITED
Calibration CERT #2246-02

09/29/2021

Summary:

This document presents the method and results from an accredited SAR reference dipole calibration performed in SATIMO USA using the COMOSAR test bench. All calibration results are traceable to national metrology institutions.

	Name	*Function*	*Date*	*Signature*
Prepared by :	Jérôme LUC	Product Manager	10/12/2021	JS
Checked by :	Jérôme LUC	Product Manager	10/12/2021	JS
Approved by :	Kim RUTKOWSKI	Quality Manager	10/12/2021	Kim Rutkowski

	Customer Name
Distribution :	Shenzhen LCS Compliance Testing Laboratory Ltd.

Issue	*Date*	*Modifications*
A	10/12/2021	Initial release

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1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209 standards for reference dipoles used for SAR measurement system validations and the measurements that were performed to verify that the product complies with the fore mentioned standards.

2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR 835 MHz REFERENCE DIPOLE
Manufacturer	Satimo
Model	SID835
Serial Number	SN 07/14 DIP 0G835-303
Product Condition (new / used)	New

A yearly calibration interval is recommended.

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

Satimo's COMOSAR Validation Dipoles are built in accordance to the IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209 standards. The product is designed for use with the COMOSAR test bench only.

Figure 1 – *Satimo COMOSAR Validation Dipole*

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4 MEASUREMENT METHOD

The IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209 standards provide requirements for reference dipoles used for system validation measurements. The following measurements were performed to verify that the product complies with the fore mentioned standards.

4.1 RETURN LOSS REQUIREMENTS

The dipole used for SAR system validation measurements and checks must have a return loss of -20 dB or better. The return loss measurement shall be performed against a liquid filled flat phantom, with the phantom constucted as outlined in the fore mentioned standards.

4.2 MECHANICAL REQUIREMENTS

The IEEE Std. 1528 and CEI/IEC 62209 standards specify the mechanical components and dimensions of the validation dipoles, with the dimensions frequency and phantom shell thickness dependent. The COMOSAR test bench employs a 2 mm phantom shell thickness therefore the dipoles sold for use with the COMOSAR test bench comply with the requirements set forth for a 2 mm phantom shell thickness.

5 MEASUREMENT UNCERTAINTY

All uncertainties listed below represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2, traceable to the Internationally Accepted Guides to Measurement Uncertainty.

5.1 RETURN LOSS

The following uncertainties apply to the return loss measurement:

Frequency band	Expanded Uncertainty on Return Loss
400-6000MHz	0.1 dB

5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

Length (mm)	Expanded Uncertainty on Length
3 - 300	0.05 mm

5.3 VALIDATION MEASUREMENT

The guidelines outlined in the IEEE 1528, OET 65 Bulletin C, CENELEC EN50361 and CEI/IEC 62209 standards were followed to generate the measurement uncertainty for validation measurements.

Scan Volume	Expanded Uncertainty
1 g	20.3 %
10 g	20.1 %

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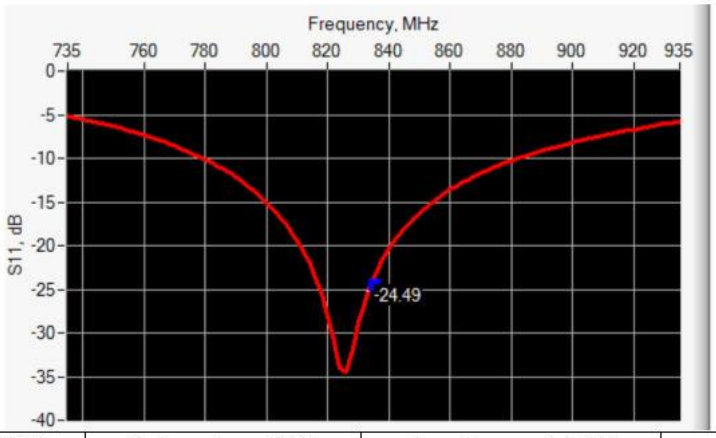
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
835	-24.49	-20	54.9 Ω + 2.8 jΩ

6.2 MECHANICAL DIMENSIONS

Frequency MHz	L mm		h mm		d mm	
	required	measured	required	measured	required	measured
300	420.0 ±1 %.		250.0 ±1 %.		6.35 ±1 %.	
450	290.0 ±1 %.		166.7 ±1 %.		6.35 ±1 %.	
750	176.0 ±1 %.		100.0 ±1 %.		6.35 ±1 %.	
835	161.0 ±1 %.	PASS	89.8 ±1 %.	PASS	3.6 ±1 %.	PASS
900	149.0 ±1 %.		83.3 ±1 %.		3.6 ±1 %.	
1450	89.1 ±1 %.		51.7 ±1 %.		3.6 ±1 %.	
1500	80.5 ±1 %.		50.0 ±1 %.		3.6 ±1 %.	
1640	79.0 ±1 %.		45.7 ±1 %.		3.6 ±1 %.	
1750	75.2 ±1 %.		42.9 ±1 %.		3.6 ±1 %.	
1800	72.0 ±1 %.		41.7 ±1 %.		3.6 ±1 %.	
1900	68.0 ±1 %.		39.5 ±1 %.		3.6 ±1 %.	
1950	66.3 ±1 %.		38.5 ±1 %.		3.6 ±1 %.	
2000	64.5 ±1 %.		37.5 ±1 %.		3.6 ±1 %.	
2100	61.0 ±1 %.		35.7 ±1 %.		3.6 ±1 %.	
2300	55.5 ±1 %.		32.6 ±1 %.		3.6 ±1 %.	
2450	51.5 ±1 %.		30.4 ±1 %.		3.6 ±1 %.	
2600	48.5 ±1 %.		28.8 ±1 %.		3.6 ±1 %.	
3000	41.5 ±1 %.		25.0 ±1 %.		3.6 ±1 %.	
3500	37.0±1 %.		26.4 ±1 %.		3.6 ±1 %.	
3700	34.7±1 %.		26.4 ±1 %.		3.6 ±1 %.	

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7 VALIDATION MEASUREMENT

The IEEE Std. 1528, OET 65 Bulletin C and CEI/IEC 62209 standards state that the system validation measurements must be performed using a reference dipole meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. Per the standards, the dipole shall be positioned below the bottom of the phantom, with the dipole length centered and parallel to the longest dimension of the flat phantom, with the top surface of the dipole at the described distance from the bottom surface of the phantom.

7.1 HEAD LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
300	45.3 ±5 %		0.87 ±5 %	
450	43.5 ±5 %		0.87 ±5 %	
750	41.9 ±5 %		0.89 ±5 %	
835	41.5 ±5 %	PASS	0.90 ±5 %	PASS
900	41.5 ±5 %		0.97 ±5 %	
1450	40.5 ±5 %		1.20 ±5 %	
1500	40.4 ±5 %		1.23 ±5 %	
1640	40.2 ±5 %		1.31 ±5 %	
1750	40.1 ±5 %		1.37 ±5 %	
1800	40.0 ±5 %		1.40 ±5 %	
1900	40.0 ±5 %		1.40 ±5 %	
1950	40.0 ±5 %		1.40 ±5 %	
2000	40.0 ±5 %		1.40 ±5 %	
2100	39.8 ±5 %		1.49 ±5 %	
2300	39.5 ±5 %		1.67 ±5 %	
2450	39.2 ±5 %		1.80 ±5 %	
2600	39.0 ±5 %		1.96 ±5 %	
3000	38.5 ±5 %		2.40 ±5 %	
3500	37.9 ±5 %		2.91 ±5 %	

7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

The IEEE Std. 1528 and CEI/IEC 62209 standards state that the system validation measurements should produce the SAR values shown below (for phantom thickness of 2 mm), within the uncertainty for the system validation. All SAR values are normalized to 1 W forward power. In bracket, the measured SAR is given with the used input power.

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Head Liquid Values: eps' : 42.3 sigma : 0.92
Distance between dipole center and liquid	15.0 mm
Area scan resolution	dx=8mm/dy=8mm

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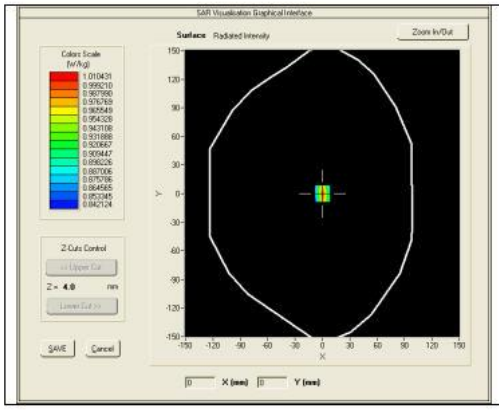
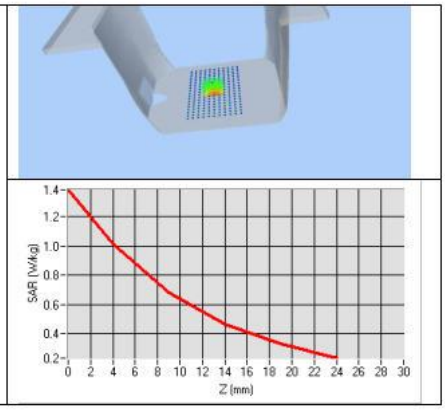
Zoon Scan Resolution	dx=8mm/dy=8m/dz=5mm
Frequency	835 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

Frequency MHz	1 g SAR (W/kg/W)		10 g SAR (W/kg/W)	
	required	measured	required	measured
300	2.85		1.94	
450	4.58		3.06	
750	8.49		5.55	
835	9.56	9.60 (0.96)	6.22	6.20 (0.62)
900	10.9		6.99	
1450	29		16	
1500	30.5		16.8	
1640	34.2		18.4	
1750	36.4		19.3	
1800	38.4		20.1	
1900	39.7		20.5	
1950	40.5		20.9	
2000	41.1		21.1	
2100	43.6		21.9	
2300	48.7		23.3	
2450	52.4		24	
2600	55.3		24.6	
3000	63.8		25.7	
3500	67.1		25	





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7.3 BODY LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
150	61.9 ±5 %		0.80 ±5 %	
300	58.2 ±5 %		0.92 ±5 %	
450	56.7 ±5 %		0.94 ±5 %	
750	55.5 ±5 %		0.96 ±5 %	
835	55.2 ±5 %	PASS	0.97 ±5 %	PASS
900	55.0 ±5 %		1.05 ±5 %	
915	55.0 ±5 %		1.06 ±5 %	
1450	54.0 ±5 %		1.30 ±5 %	
1610	53.8 ±5 %		1.40 ±5 %	
1800	53.3 ±5 %		1.52 ±5 %	
1900	53.3 ±5 %		1.52 ±5 %	
2000	53.3 ±5 %		1.52 ±5 %	
2100	53.2 ±5 %		1.62 ±5 %	
2450	52.7 ±5 %		1.95 ±5 %	
2600	52.5 ±5 %		2.16 ±5 %	
3000	52.0 ±5 %		2.73 ±5 %	
3500	51.3 ±5 %		3.31 ±5 %	
5200	49.0 ±10 %		5.30 ±10 %	
5300	48.9 ±10 %		5.42 ±10 %	
5400	48.7 ±10 %		5.53 ±10 %	
5500	48.6 ±10 %		5.65 ±10 %	
5600	48.5 ±10 %		5.77 ±10 %	
5800	48.2 ±10 %		6.00 ±10 %	

7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Body Liquid Values: eps' : 54.1 sigma : 0.97
Distance between dipole center and liquid	15.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=8mm/dy=8m/dz=5mm
Frequency	835 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

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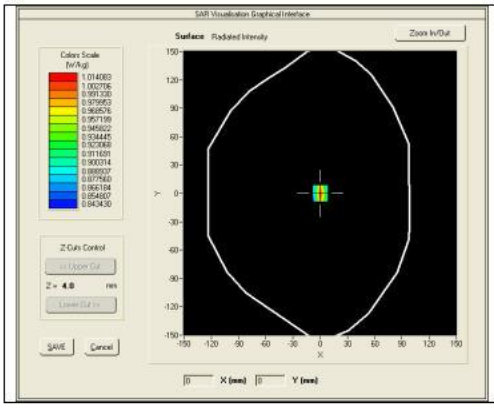
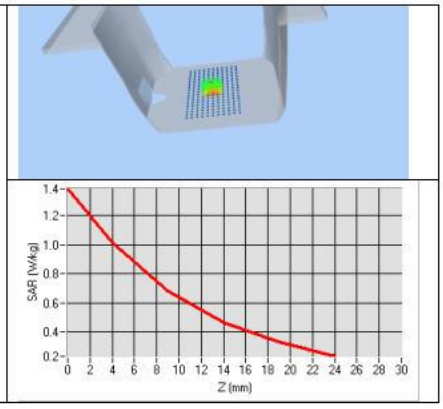
Frequency MHz	1 g SAR (W/kg/W)	10 g SAR (W/kg/W)
	measured	measured
835	9.90 (0.99)	6.39 (0.64)





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8 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	**Manufacturer / Model**	**Identification No.**	**Current Calibration Date**	**Next Calibration Date**
SAM Phantom	Satimo	SN-20/09-SAM71	Validated. No cal required.	Validated. No cal required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rhode & Schwarz ZVA	SN100132	02/2021	02/2024
Calipers	Carrera	CALIPER-01	12/2018	12/2021
Reference Probe	Satimo	EPG122 SN 18/11	10/2021	10/2022
Multimeter	Keithley 2000	1188656	12/2018	12/2021
Signal Generator	Agilent E4438C	MY49070581	12/2018	12/2021
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	12/2018	12/2021
Power Sensor	HP ECP-E26A	US37181460	12/2018	12/2021
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Temperature and Humidity Sensor	Control Company	11-661-9	8/2021	8/2024

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5.3 SID1900 Dipole Calibration Certificate

SAR Reference Dipole Calibration Report

Ref : ACR.273.2.18.SATU.A

SHENZHEN LCS COMPLIANCE TESTING LABORATORY LTD.

1F., XINGYUAN INDUSTRIAL PARK, TONGDA ROAD, BAO'AN BLVD

BAO'AN DISTRICT, SHENZHEN, GUANGDONG, CHINA

MVG COMOSAR REFERENCE DIPOLE

FREQUENCY: 1900 MHZ

SERIAL NO.: SN 38/18 DIP 1G900-466

Calibrated at MVG US

2105 Barrett Park Dr. - Kennesaw, GA 30144

Calibration Date: 09/22/2021

Summary:

This document presents the method and results from an accredited SAR reference dipole calibration performed in MVG USA using the COMOSAR test bench. All calibration results are traceable to national metrology institutions.

SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.273.2.18.SATU.A

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	09/28/2021	
Checked by :	Jérôme LUC	Product Manager	09/28/2021	
Approved by :	Kim RUTKOWSKI	Quality Manager	09/28/2021	Kim Rutkowski

	Customer Name
Distribution :	Shenzhen LCS Compliance Testing Laboratory Ltd.

Issue	Date	Modifications
A	09/28/2021	Initial release

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1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEEE 1528, FCC KDBs and CEI/IEC 62209 standards for reference dipoles used for SAR measurement system validations and the measurements that were performed to verify that the product complies with the fore mentioned standards.

2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR 1900 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID1900
Serial Number	SN 38/18 DIP 1G900-466
Product Condition (new / used)	Used

A yearly calibration interval is recommended.

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

MVG's COMOSAR Validation Dipoles are built in accordance to the IEEE 1528, FCC KDBs and CEI/IEC 62209 standards. The product is designed for use with the COMOSAR test bench only.

Figure 1 – *MVG COMOSAR Validation Dipole*

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4 MEASUREMENT METHOD

The IEEE 1528, FCC KDBs and CEI/IEC 62209 standards provide requirements for reference dipoles used for system validation measurements. The following measurements were performed to verify that the product complies with the fore mentioned standards.

4.1 RETURN LOSS REQUIREMENTS

The dipole used for SAR system validation measurements and checks must have a return loss of -20 dB or better. The return loss measurement shall be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards.

4.2 MECHANICAL REQUIREMENTS

The IEEE Std. 1528 and CEI/IEC 62209 standards specify the mechanical components and dimensions of the validation dipoles, with the dimensions frequency and phantom shell thickness dependent. The COMOSAR test bench employs a 2 mm phantom shell thickness therefore the dipoles sold for use with the COMOSAR test bench comply with the requirements set forth for a 2 mm phantom shell thickness.

5 MEASUREMENT UNCERTAINTY

All uncertainties listed below represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2, traceable to the Internationally Accepted Guides to Measurement Uncertainty.

5.1 RETURN LOSS

The following uncertainties apply to the return loss measurement:

Frequency band	Expanded Uncertainty on Return Loss
400-6000MHz	0.1 dB

5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

Length (mm)	Expanded Uncertainty on Length
3 - 300	0.05 mm

5.3 VALIDATION MEASUREMENT

The guidelines outlined in the IEEE 1528, FCC KDBs, CENELEC EN50361 and CEI/IEC 62209 standards were followed to generate the measurement uncertainty for validation measurements.

Scan Volume	Expanded Uncertainty
1 g	20.3 %

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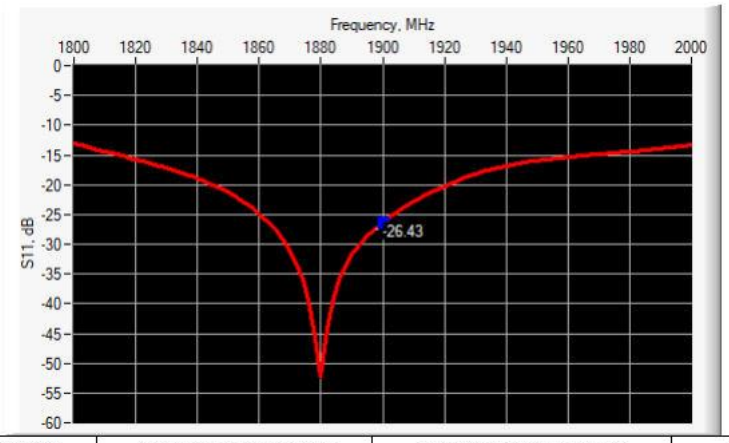
10 g	20.1 %

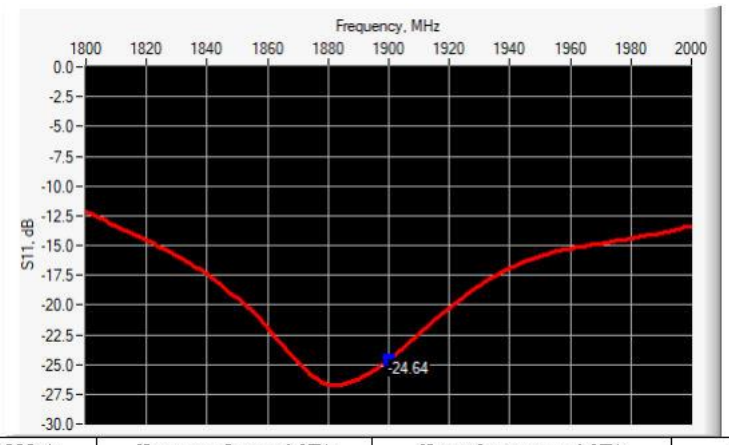
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
1900	-26.43	-20	50.5 Ω + 4.7 jΩ

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
1900	-24.64	-20	46.2 Ω + 4.4 jΩ

6.3 MECHANICAL DIMENSIONS

Frequency MHz	L mm		h mm		d mm	
	required	measured	required	measured	required	measured
300	420.0 ±1 %.		250.0 ±1 %.		6.35 ±1 %.	

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450	290.0 ±1 %.		166.7 ±1 %.		6.35 ±1 %.	
750	176.0 ±1 %.		100.0 ±1 %.		6.35 ±1 %.	
835	161.0 ±1 %.		89.8 ±1 %.		3.6 ±1 %.	
900	149.0 ±1 %.		83.3 ±1 %.		3.6 ±1 %.	
1450	89.1 ±1 %.		51.7 ±1 %.		3.6 ±1 %.	
1500	80.5 ±1 %.		50.0 ±1 %.		3.6 ±1 %.	
1640	79.0 ±1 %.		45.7 ±1 %.		3.6 ±1 %.	
1750	75.2 ±1 %.		42.9 ±1 %.		3.6 ±1 %.	
1800	72.0 ±1 %.		41.7 ±1 %.		3.6 ±1 %.	
1900	68.0 ±1 %.	PASS	39.5 ±1 %.	PASS	3.6 ±1 %.	PASS
1950	66.3 ±1 %.		38.5 ±1 %.		3.6 ±1 %.	
2000	64.5 ±1 %.		37.5 ±1 %.		3.6 ±1 %.	
2100	61.0 ±1 %.		35.7 ±1 %.		3.6 ±1 %.	
2300	55.5 ±1 %.		32.6 ±1 %.		3.6 ±1 %.	
2450	51.5 ±1 %.		30.4 ±1 %.		3.6 ±1 %.	
2600	48.5 ±1 %.		28.8 ±1 %.		3.6 ±1 %.	
3000	41.5 ±1 %.		25.0 ±1 %.		3.6 ±1 %.	
3500	37.0±1 %.		26.4 ±1 %.		3.6 ±1 %.	
3700	34.7±1 %.		26.4 ±1 %.		3.6 ±1 %.	

7 VALIDATION MEASUREMENT

The IEEE Std. 1528, FCC KDBs and CEI/IEC 62209 standards state that the system validation measurements must be performed using a reference dipole meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. Per the standards, the dipole shall be positioned below the bottom of the phantom, with the dipole length centered and parallel to the longest dimension of the flat phantom, with the top surface of the dipole at the described distance from the bottom surface of the phantom.

7.1 HEAD LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
300	45.3 ±5 %		0.87 ±5 %	
450	43.5 ±5 %		0.87 ±5 %	
750	41.9 ±5 %		0.89 ±5 %	
835	41.5 ±5 %		0.90 ±5 %	
900	41.5 ±5 %		0.97 ±5 %	
1450	40.5 ±5 %		1.20 ±5 %	
1500	40.4 ±5 %		1.23 ±5 %	
1640	40.2 ±5 %		1.31 ±5 %	
1750	40.1 ±5 %		1.37 ±5 %	

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1800	40.0 ±5 %		1.40 ±5 %	
1900	40.0 ±5 %	PASS	1.40 ±5 %	PASS
1950	40.0 ±5 %		1.40 ±5 %	
2000	40.0 ±5 %		1.40 ±5 %	
2100	39.8 ±5 %		1.49 ±5 %	
2300	39.5 ±5 %		1.67 ±5 %	
2450	39.2 ±5 %		1.80 ±5 %	
2600	39.0 ±5 %		1.96 ±5 %	
3000	38.5 ±5 %		2.40 ±5 %	
3500	37.9 ±5 %		2.91 ±5 %	

7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

The IEEE Std. 1528 and CEI/IEC 62209 standards state that the system validation measurements should produce the SAR values shown below (for phantom thickness of 2 mm), within the uncertainty for the system validation. All SAR values are normalized to 1 W forward power. In bracket, the measured SAR is given with the used input power.

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Head Liquid Values: eps' : 38.5 sigma : 1.45
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoom Scan Resolution	dx=8mm/dy=8mm/dz=5mm
Frequency	1900 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

Frequency MHz	1 g SAR (W/kg/W)		10 g SAR (W/kg/W)	
	required	measured	required	measured
300	2.85		1.94	
450	4.58		3.06	
750	8.49		5.55	
835	9.56		6.22	
900	10.9		6.99	
1450	29		16	
1500	30.5		16.8	
1640	34.2		18.4	
1750	36.4		19.3	
1800	38.4		20.1	

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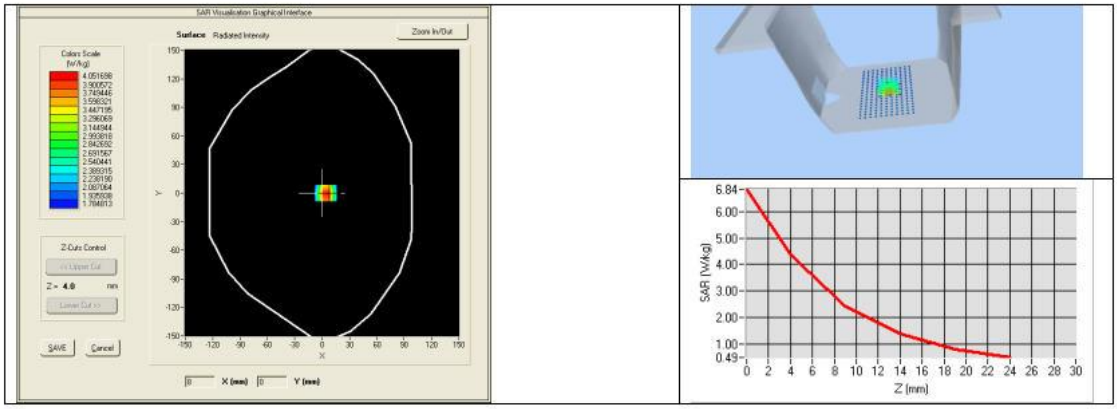
1900	39.7	40.03 (4.00)	20.5	20.55 (2.06)
1950	40.5		20.9	
2000	41.1		21.1	
2100	43.6		21.9	
2300	48.7		23.3	
2450	52.4		24	
2600	55.3		24.6	
3000	63.8		25.7	
3500	67.1		25	
3700	67.4		24.2	



7.3 BODY LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
150	61.9 ±5 %		0.80 ±5 %	
300	58.2 ±5 %		0.92 ±5 %	
450	56.7 ±5 %		0.94 ±5 %	
750	55.5 ±5 %		0.96 ±5 %	
835	55.2 ±5 %		0.97 ±5 %	
900	55.0 ±5 %		1.05 ±5 %	
915	55.0 ±5 %		1.06 ±5 %	
1450	54.0 ±5 %		1.30 ±5 %	
1610	53.8 ±5 %		1.40 ±5 %	
1800	53.3 ±5 %		1.52 ±5 %	
1900	53.3 ±5 %	PASS	1.52 ±5 %	PASS
2000	53.3 ±5 %		1.52 ±5 %	
2100	53.2 ±5 %		1.62 ±5 %	

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