



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.

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	2.0	5	0.066
Bluetooth*	2450	Body-worn	2.0	5	0.066

Remark:

1. Bluetooth*-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 0mm from manufacturer declaration of user manual

4.5. 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 transmitting 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+BT

4.4.2 Evaluation of Simultaneous SAR

Body Hotspot Exposure Conditions

Simultaneous transmission SAR for WiFi and GSM

Test Position	GSM850 Reported SAR _{1-g} (W/kg)	GSM1900 Reported SAR _{1-g} (W/kg)	WiFi2.4G Reported SAR _{1-g} (W/kg)	WiFi5.2G Reported SAR _{1-g} (W/kg)	WiFi5.8G Reported SAR _{1-g} (W/kg)	MAX. ΣSAR _{1-g} (W/kg)	SAR _{1-g} Limit (W/kg)	Peak location separation ratio	Simut Meas. Required
Front	0.261	0.193	0.166	0.140	0.094	0.427	1.6	no	no
Rear	0.340	0.281	0.260	0.229	0.146	0.600	1.6	no	no
Left	0.249	0.175	0.143	0.127	0.076	0.392	1.6	no	no
Right	/	/	/			/	1.6	no	no
Bottom	/	/	/			/	1.6	no	no
Top	/	/	/			/	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)	WiFi5.2G Reported SAR1-g (W/kg)	WiFi5.8G Reported SAR1-g (W/kg)	MAX. ΣSAR1-g (W/kg)	SAR1-g Limit (W/kg)	Peak location separation ratio	Simut Meas. Required
Front	0.159	0.487	0.166	0.140	0.094	0.653	1.6	no	no
Rear	0.241	0.532	0.260	0.229	0.146	0.792	1.6	no	no
Left	0.144	0.472	0.143	0.127	0.076	0.615	1.6	no	no
Right	/	/	/			/	1.6	no	no
Bottom	/	/	/			/	1.6	no	no
Top	/	/	/			/	1.6	no	no

SAR for WiFi and LTE

Reported SAR1-g(W/kg)	Test Position					
	Front	Rear	Left	Right	Bottom	Top
LTE Band2	0.359	0.478	0.349	/	/	/
LTE Band4	0.478	0.525	0.465	/	/	/
LTE Band5	0.125	0.234	0.112	/	/	/
LTE Band12	0.043	0.070	0.036	/	/	/
LTE Band17	0.038	0.063	0.033	/	/	/
WiFi2.4G	0.166	0.260	0.143	/	/	/
WiFi5.2G	0.140	0.229	0.127	/	/	/
WiFi5.8G	0.094	0.146	0.076	/	/	/
MAX. ΣSAR1-g (W/kg)	0.644	0.785	0.608	/	/	/
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	0.261	0.193	0.066	0.327	1.6	no	no
Rear	0.340	0.281	0.066	0.406	1.6	no	no
Left	0.249	0.175	0.066	0.315	1.6	no	no
Right	/	/	/	/	1.6	no	no
Bottom	/	/	/	/	1.6	no	no
Top	/	/	/	/	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	0.159	0.487	0.066	0.553	1.6	no	no
Rear	0.241	0.532	0.066	0.598	1.6	no	no
Left	0.144	0.472	0.066	0.538	1.6	no	no
Right	/	/	/	/	1.6	no	no
Bottom	/	/	/	/	1.6	no	no
Top	/	/	/	/	1.6	no	no





Simultaneous transmission SAR for BT and LTE

Reported SAR1-g(W/kg)	Test Position					
	Front	Rear	Left	Right	Bottom	Top
LTE Band2	0.359	0.478	0.349	/	/	/
LTE Band4	0.478	0.525	0.465	/	/	/
LTE Band5	0.125	0.234	0.112	/	/	/
LTE Band12	0.043	0.070	0.036	/	/	/
LTE Band17	0.038	0.063	0.033	/	/	/
BT Estimated SAR1-g (W/kg)	0.066	0.066	0.066	/	/	/
MAX. ΣSAR1-g (W/kg)	0.544	0.591	0.531	/	/	/
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

- Note:
- 1. The WiFi and BT share same antenna, so cannot transmit at same time.
 - 2. The value with black color is the maximum values of standalone
 - 3. The value with blue color is the maximum values of Σ SAR1-g

4.6. 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 $\leq 20\%$ 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	
						Measured SAR _{1-g} (W/Kg)	Largest to Smallest SAR Ratio
750	LTE Band 12	Standalone	Body-Rear	no	0.069	n/a	n/a
	LTE Band 17	Standalone	Body-Rear	no	0.061	n/a	n/a
850	GSM 850	Standalone	Body-Rear	no	0.333	n/a	n/a
	WCDMA Band V	Standalone	Body-Rear	no	0.215	n/a	n/a
	LTE Band 5	Standalone	Body-Rear	no	0.213	n/a	n/a
1800	WCDMA Band IV	Standalone	Body-Rear	no	0.265	n/a	n/a
	LTE Band 4	Standalone	Body-Rear	no	0.508	n/a	n/a
1900	GSM 1900	Standalone	Body-Rear	no	0.275	n/a	n/a
	WCDMA Band II	Standalone	Body-Rear	no	0.505	n/a	n/a
	LTE Band 2	Standalone	Body-Rear	no	0.433	n/a	n/a
2450	2.4GWLAN	Standalone	Body-Rear	no	0.258	n/a	n/a
5200	5.2GWLAN	Standalone	Body-Rear	no	0.222	n/a	n/a
5800	5.8GWLAN	Standalone	Body-Rear	no	0.132	n/a	n/a

Remark:

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

4.7. 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 $> 1/2$ 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.

4.8. 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 according to KDB865664D01.

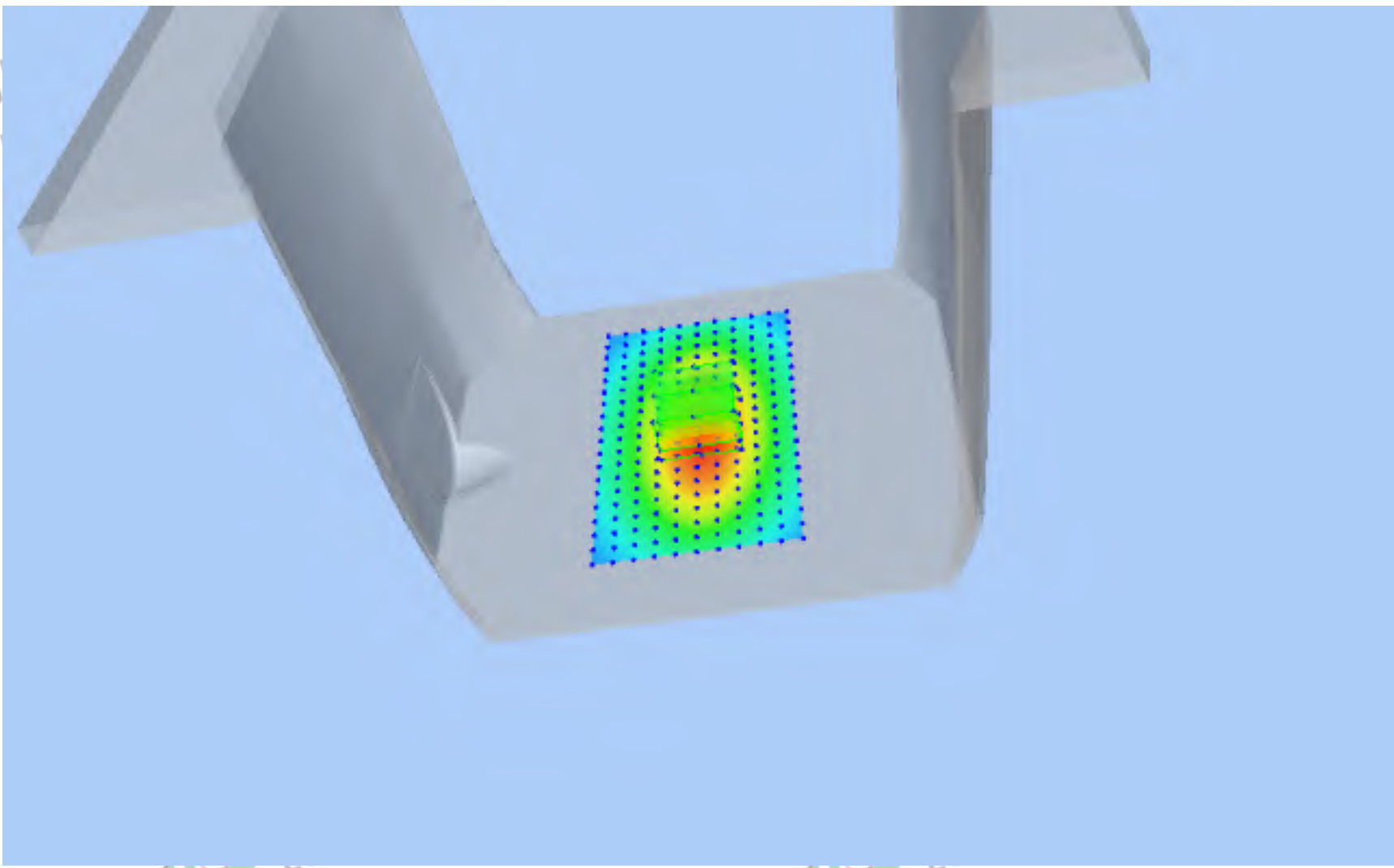
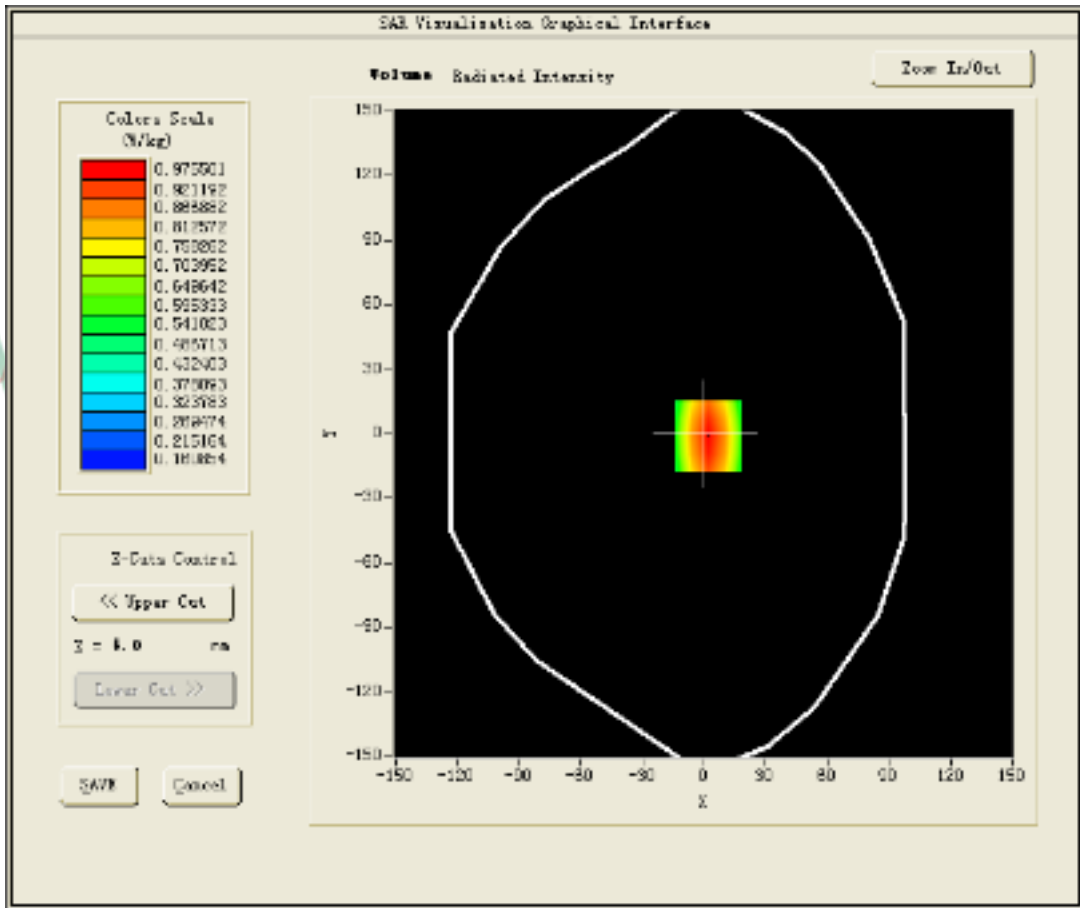
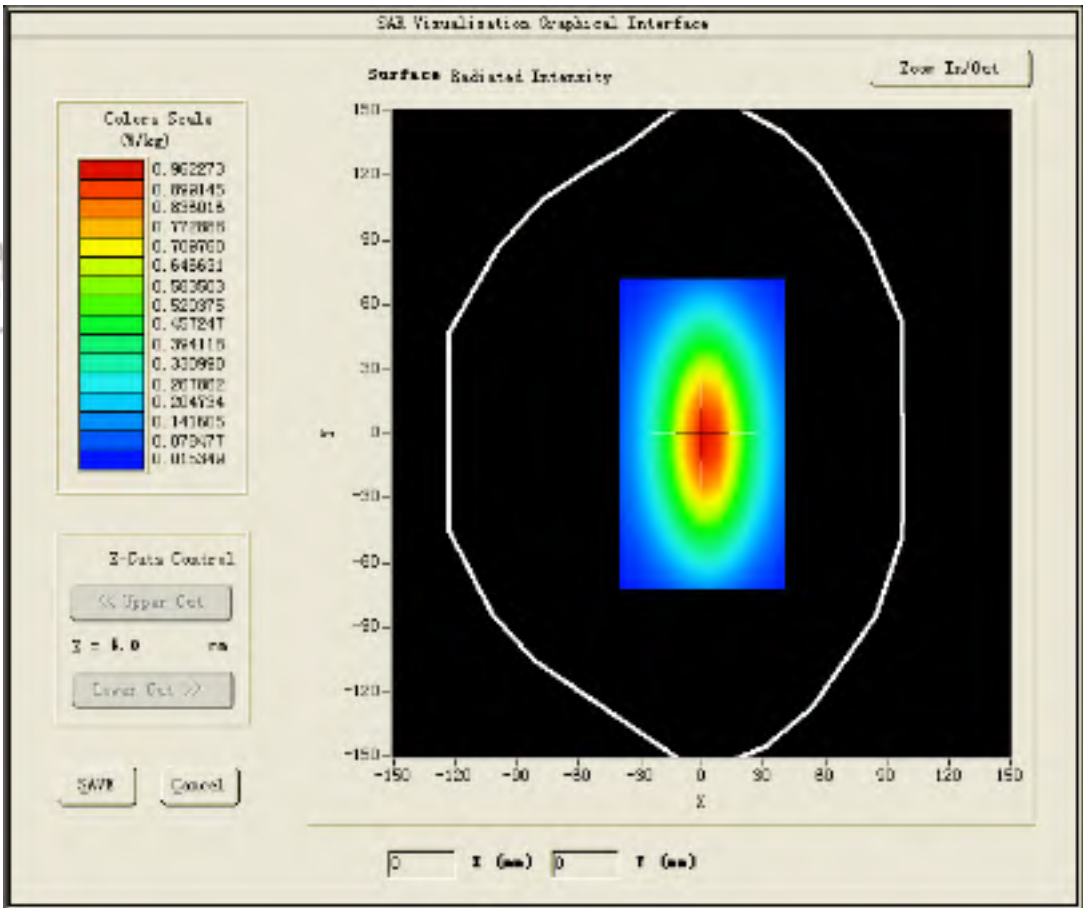




4.9. System Check Results

Test mode:750MHz(Body)
Product Description:Validation
Model:Dipole SID750
E-Field Probe: SSE2(SN 25/22 EPGO376)
Test Date: June 22, 2023

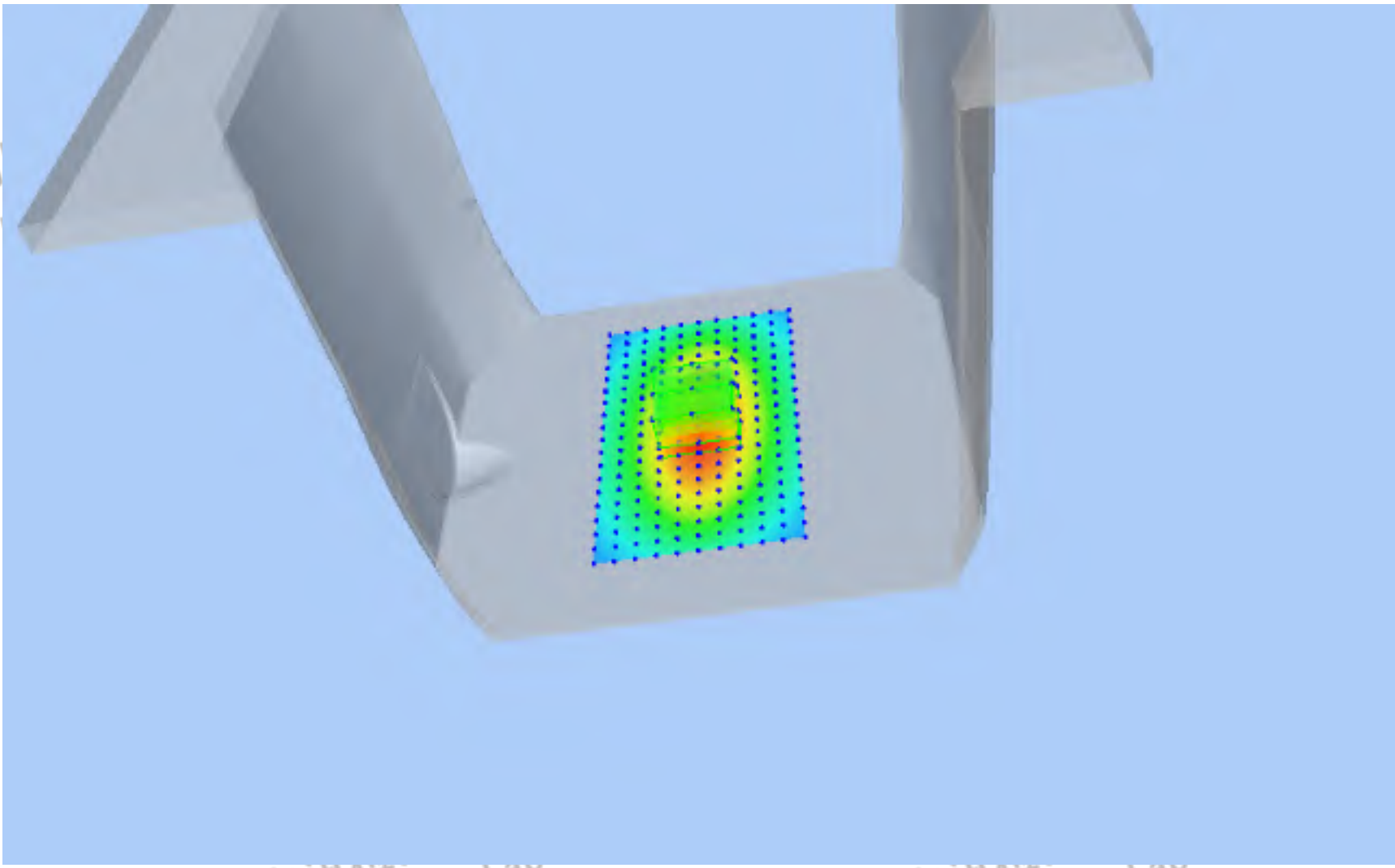
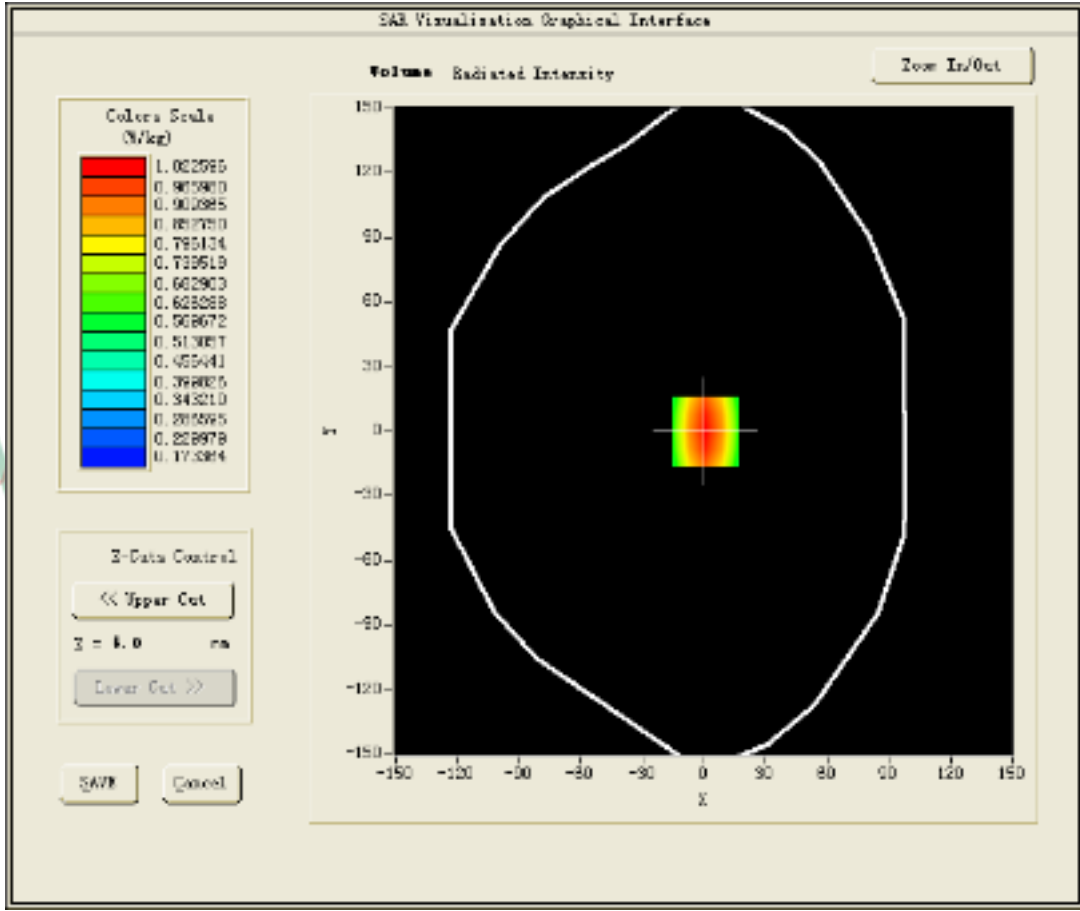
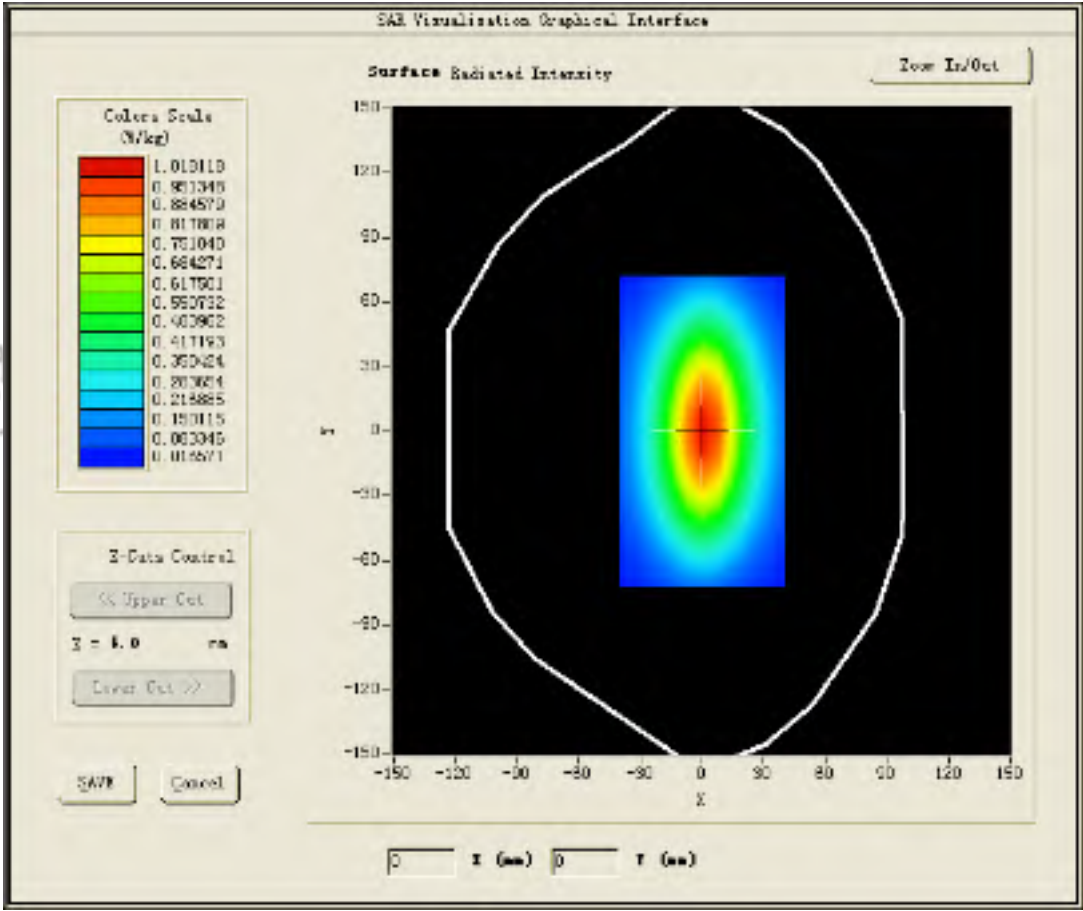
Medium(liquid type)	MSL_750
Frequency (MHz)	750.0000
Relative permittivity (real part)	55.63
Conductivity (S/m)	0.94
Input power	100mW
Crest Factor	1.0
Conversion Factor	1.73
Variation (%)	3.540000
SAR 10g (W/Kg)	0.562452
SAR 1g (W/Kg)	0.858413
SURFACE SAR	VOLUME SAR





Test mode:835MHz(Body)
Product Description:Validation
Model:Dipole SID835
E-Field Probe:SSE2(SN 25/22 EPGO376)
Test Date: June 26, 2023

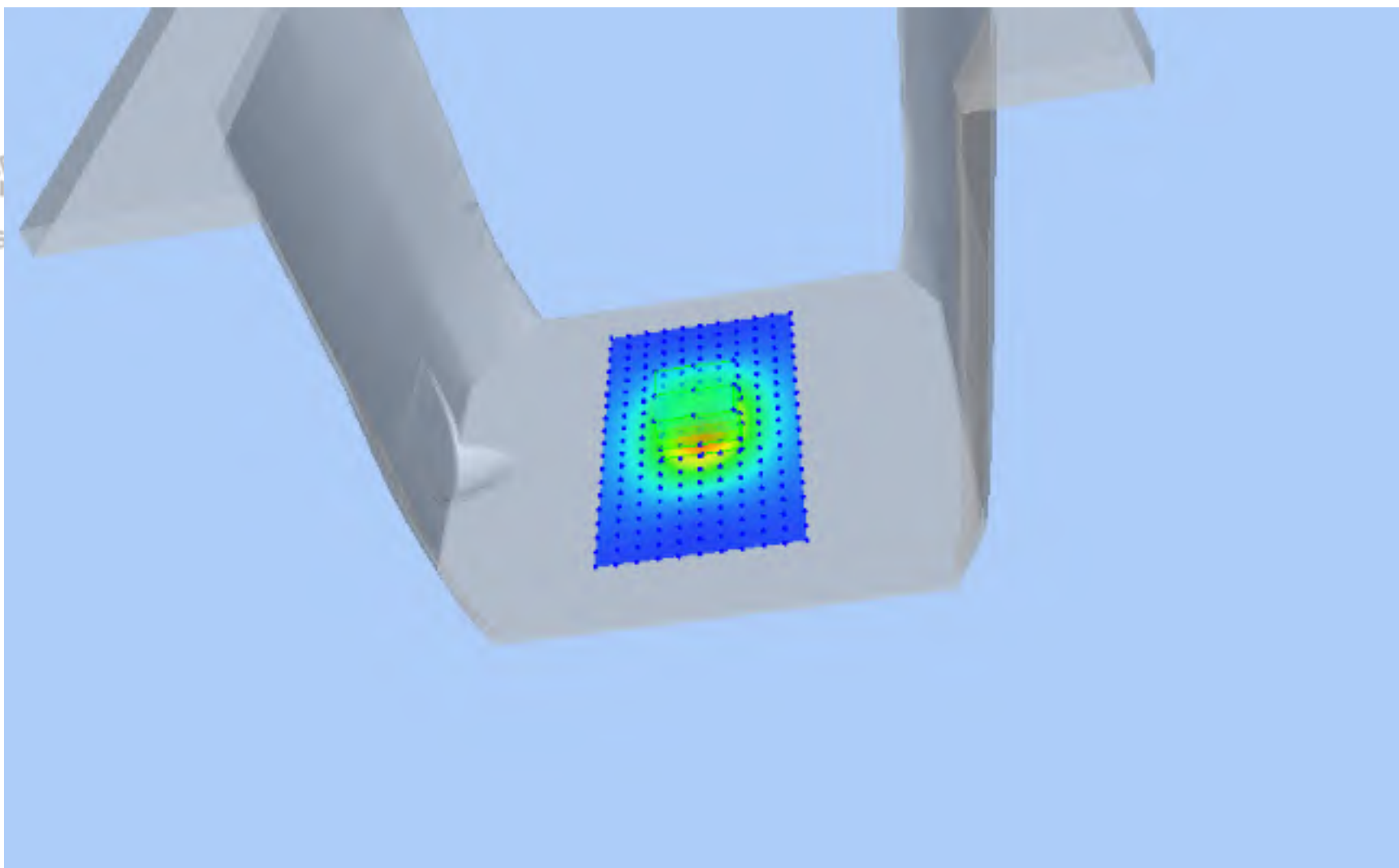
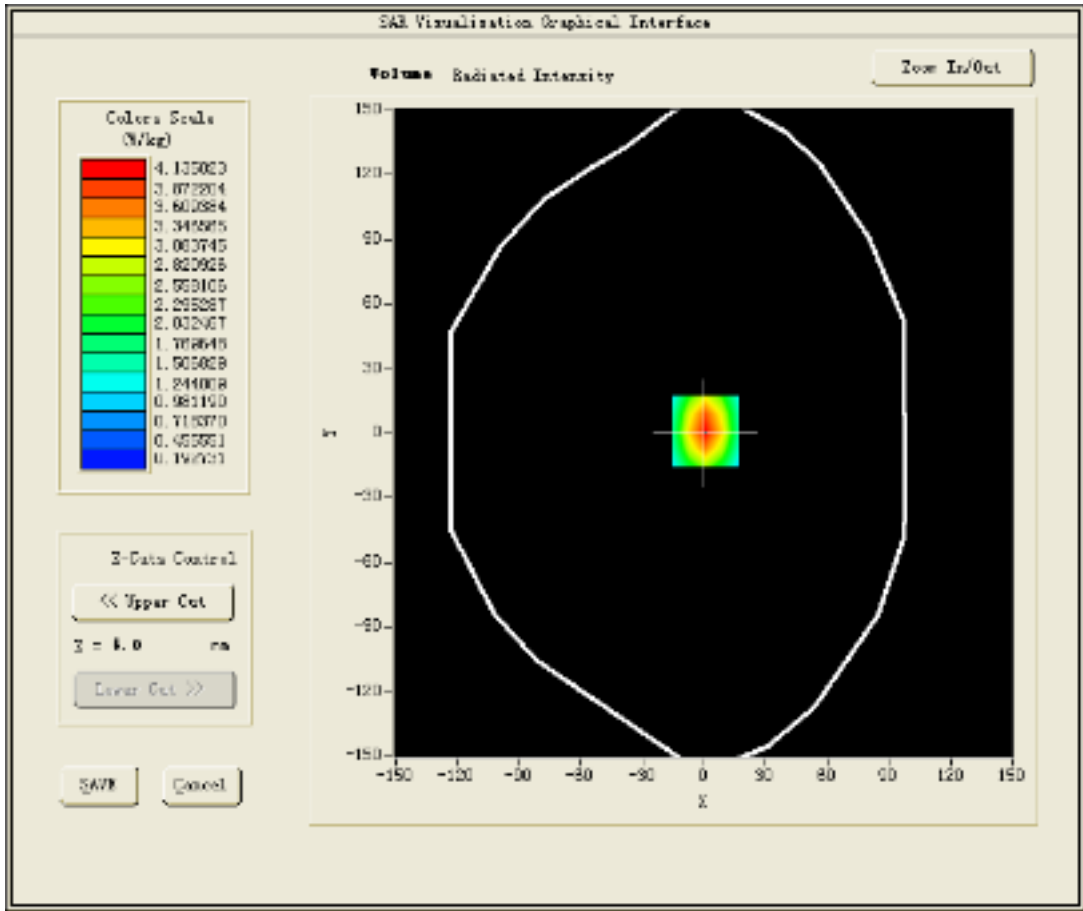
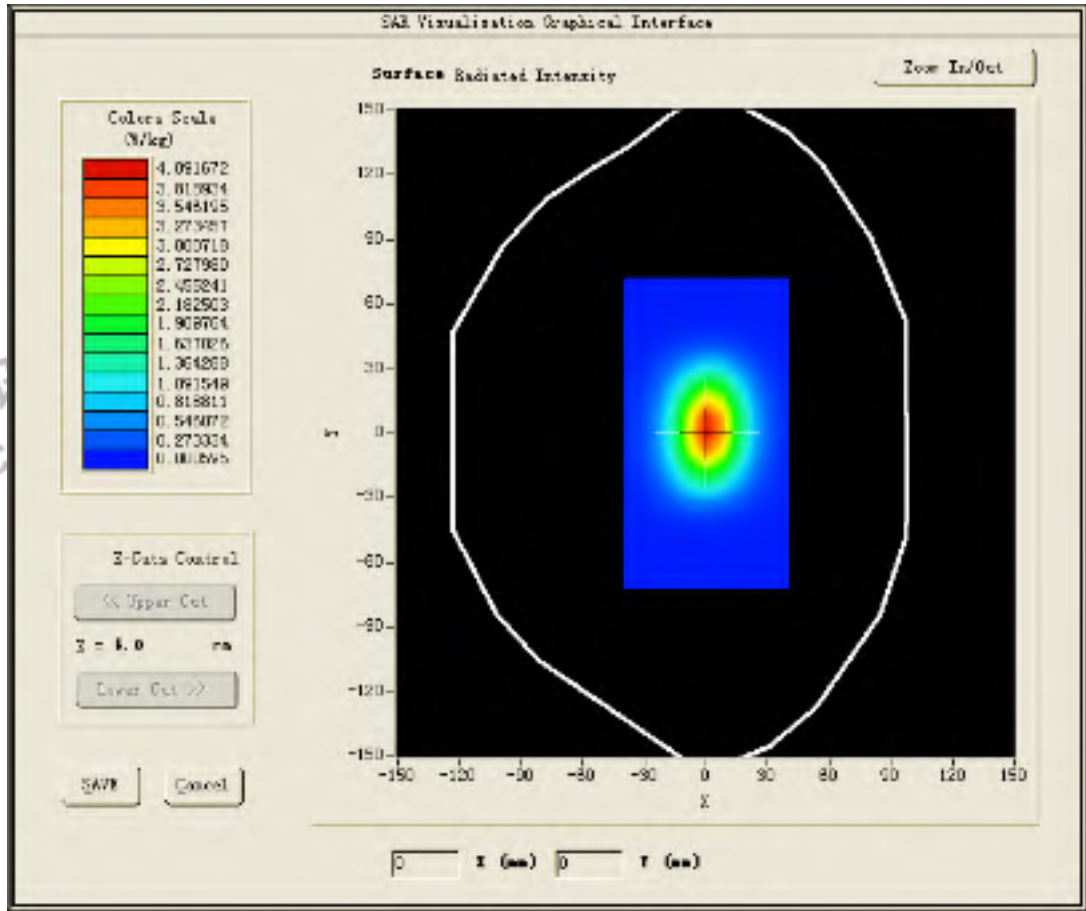
Medium(liquid type)	MSL_835
Frequency (MHz)	835.0000
Relative permittivity (real part)	55.36
Conductivity (S/m)	0.95
Input power	100mW
Crest Factor	1.0
Conversion Factor	1.80
Variation (%)	-3.980000
SAR 10g (W/Kg)	0.622132
SAR 1g (W/Kg)	0.974488
SURFACE SAR	VOLUME SAR





Test mode:1800MHz(Body)
Product Description:Validation
Model :Dipole SID1800
E-Field Probe:SSE2(SN 25/22 EPGO376)
Test Date: June 28, 2023

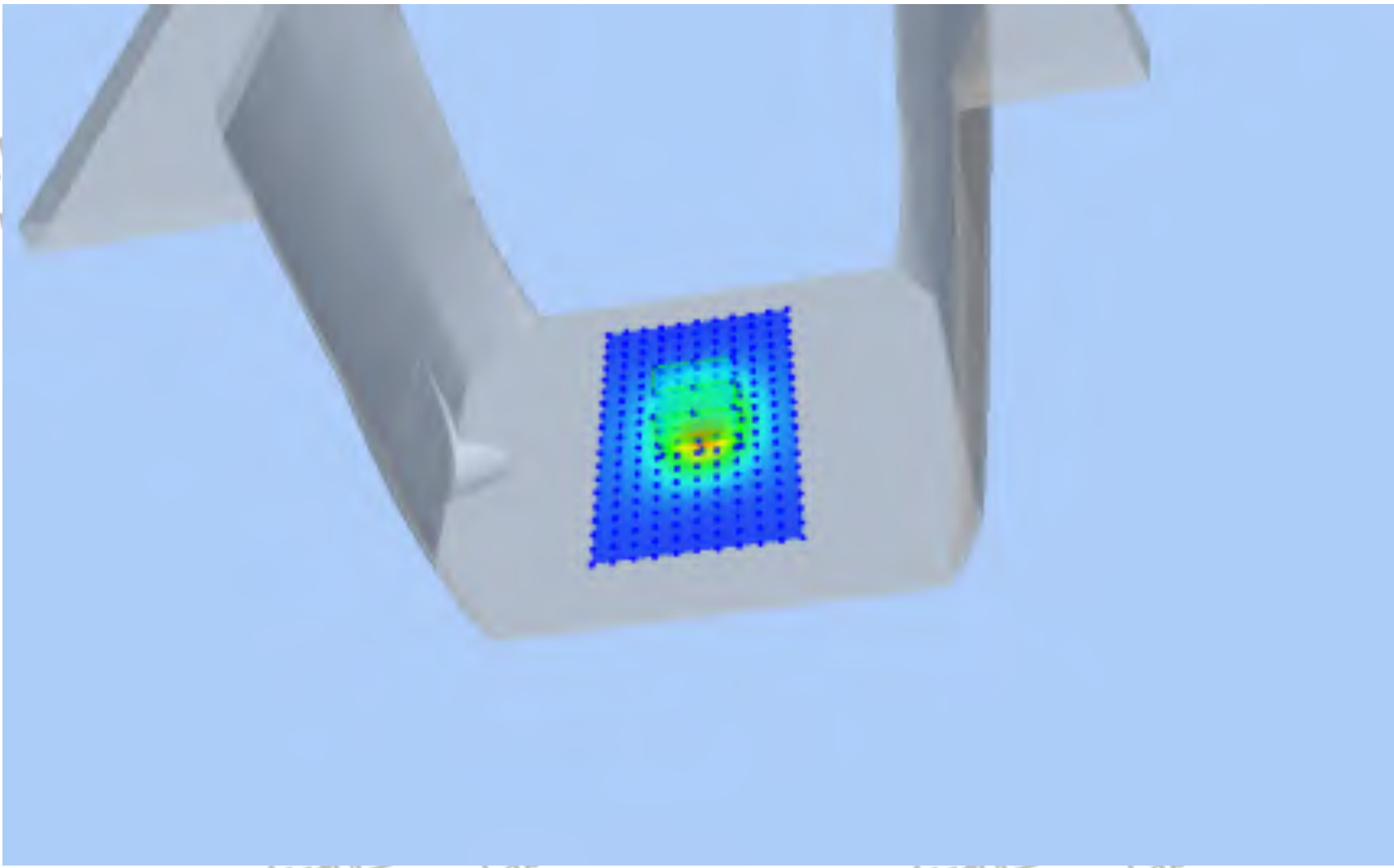
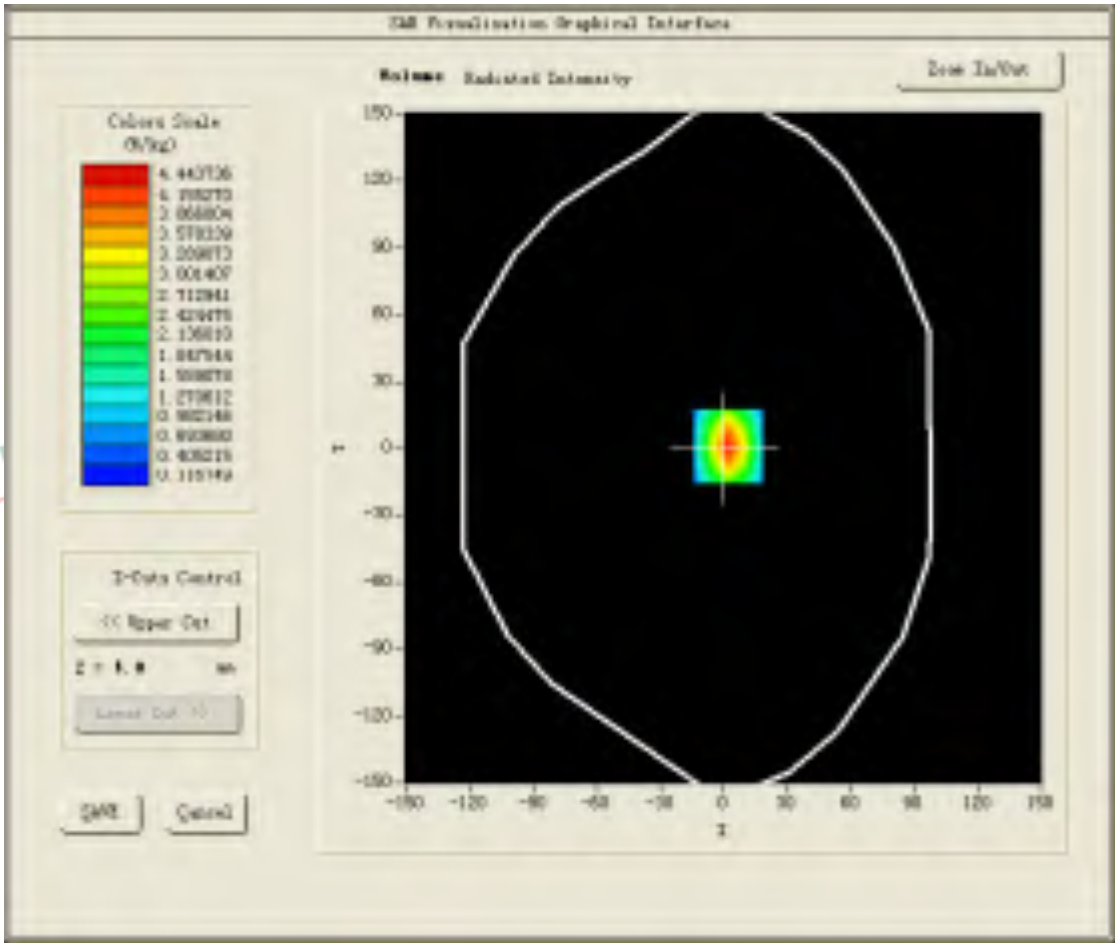
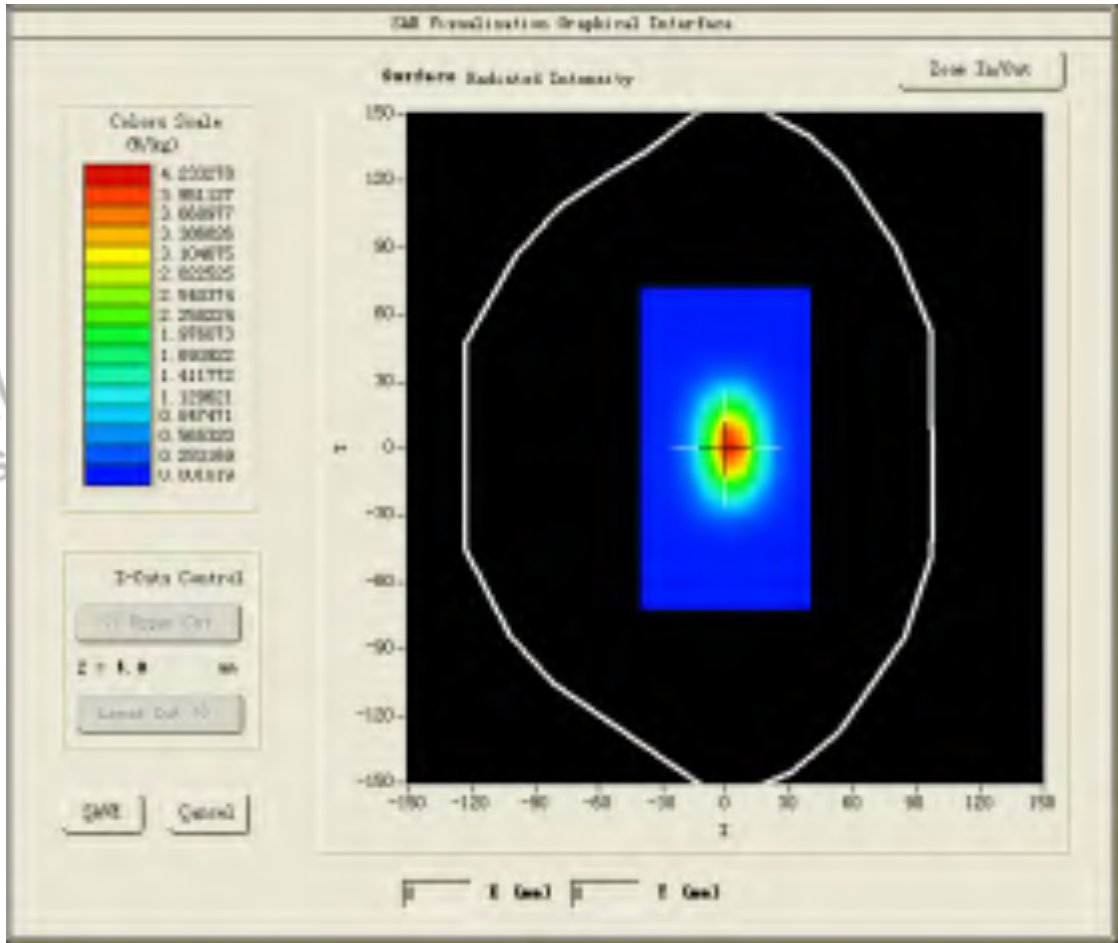
Medium(liquid type)	MSL_1800
Frequency (MHz)	1800.0000
Relative permittivity (real part)	55.42
Conductivity (S/m)	1.50
Input power	100mW
Crest Factor	1.0
Conversion Factor	2.15
Variation (%)	-4.360000
SAR 10g (W/Kg)	2.051283
SAR 1g (W/Kg)	3.893085
SURFACE SAR	VOLUME SAR





Test mode:1900MHz(Body)
Product Description:Validation
Model :Dipole SID1900
E-Field Probe:SSE2(SN 25/22 EPG0376)
Test Date: June 29, 2023

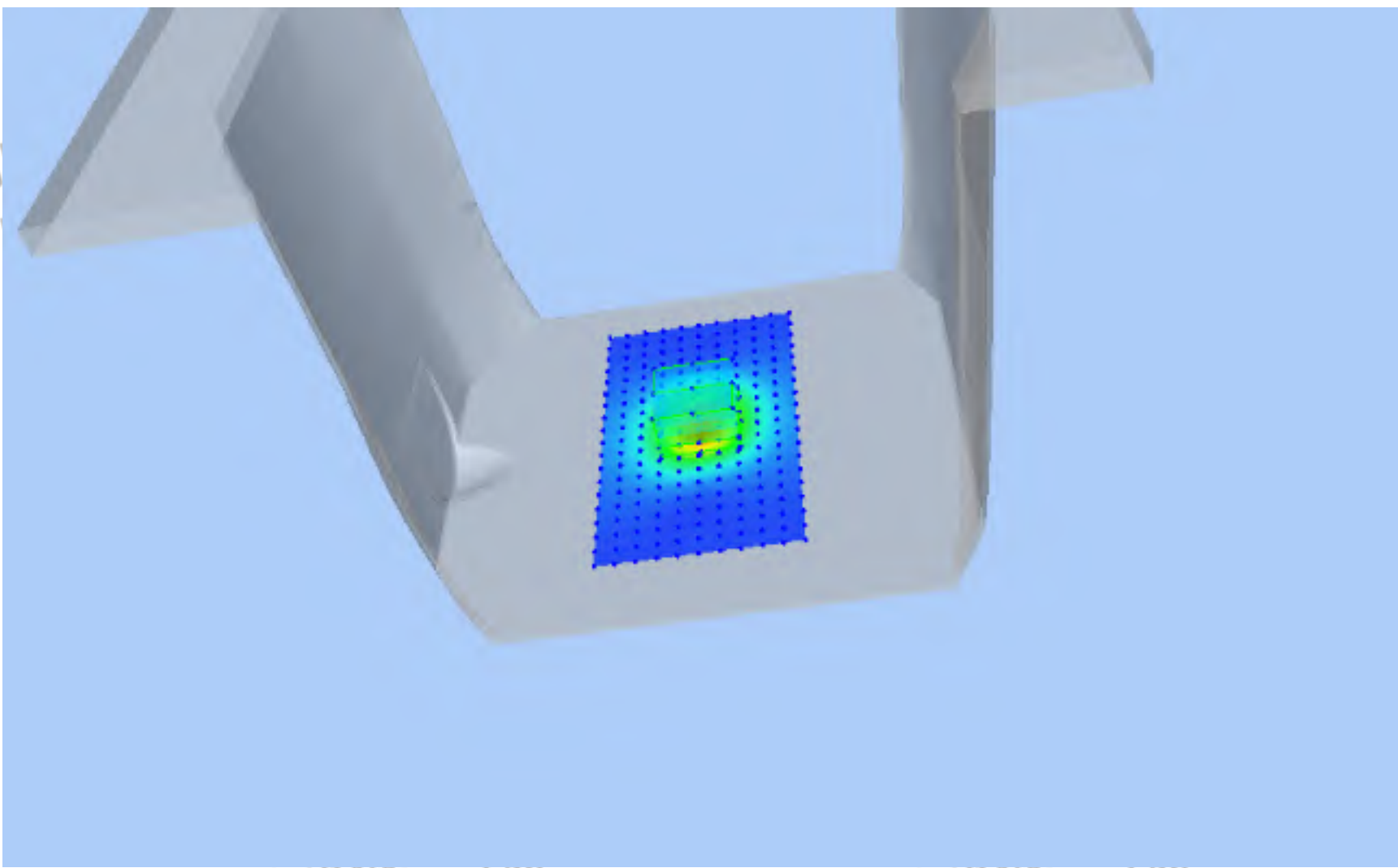
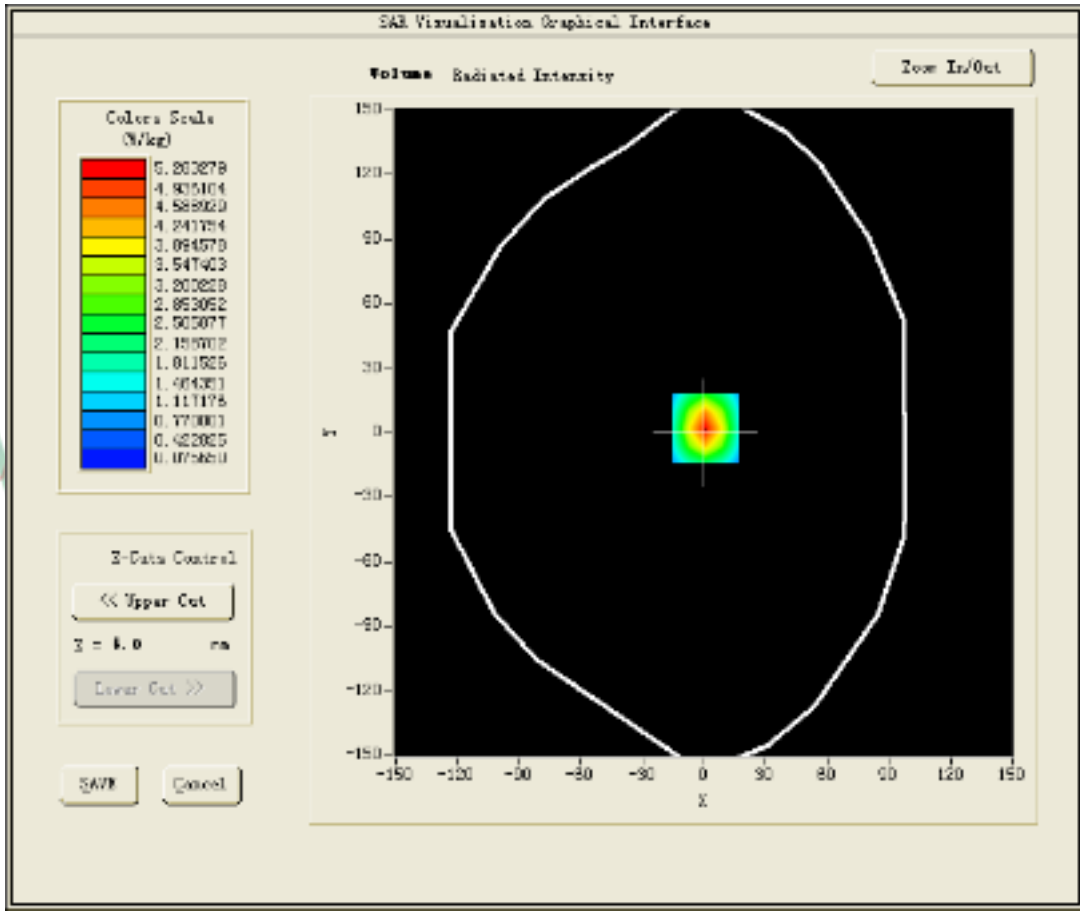
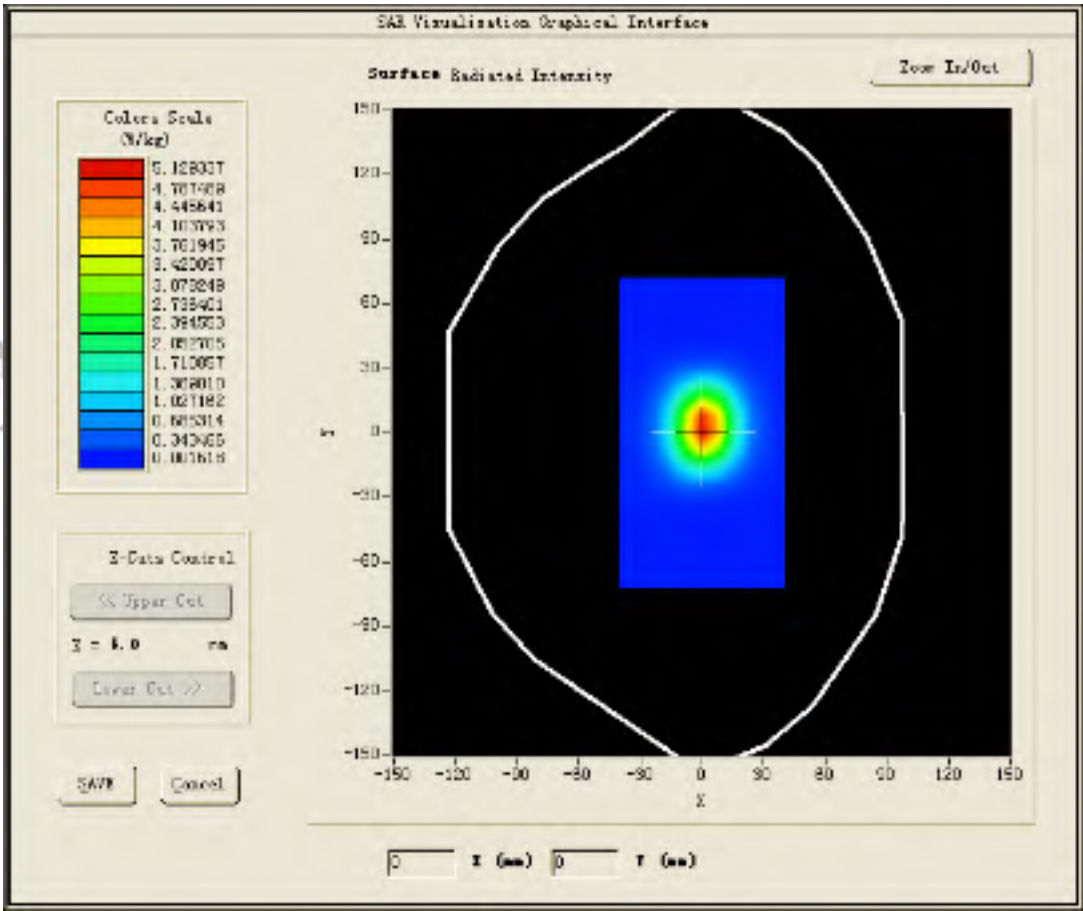
Medium(liquid type)	MSL_1900
Frequency (MHz)	1900.0000
Relative permittivity (real part)	53.14
Conductivity (S/m)	1.53
Input power	100mW
Crest Factor	1.0
Conversion Factor	2.27
Variation (%)	2.950000
SAR 10g (W/Kg)	2.098260
SAR 1g (W/Kg)	3.974162
SURFACE SAR	VOLUME SAR





Test mode:2450MHz(Body)
Product Description:Validation
Model:Dipole SID2450
E-Field Probe:SSE2(SN 25/22 EPGO376)
Test Date: July 04, 2023

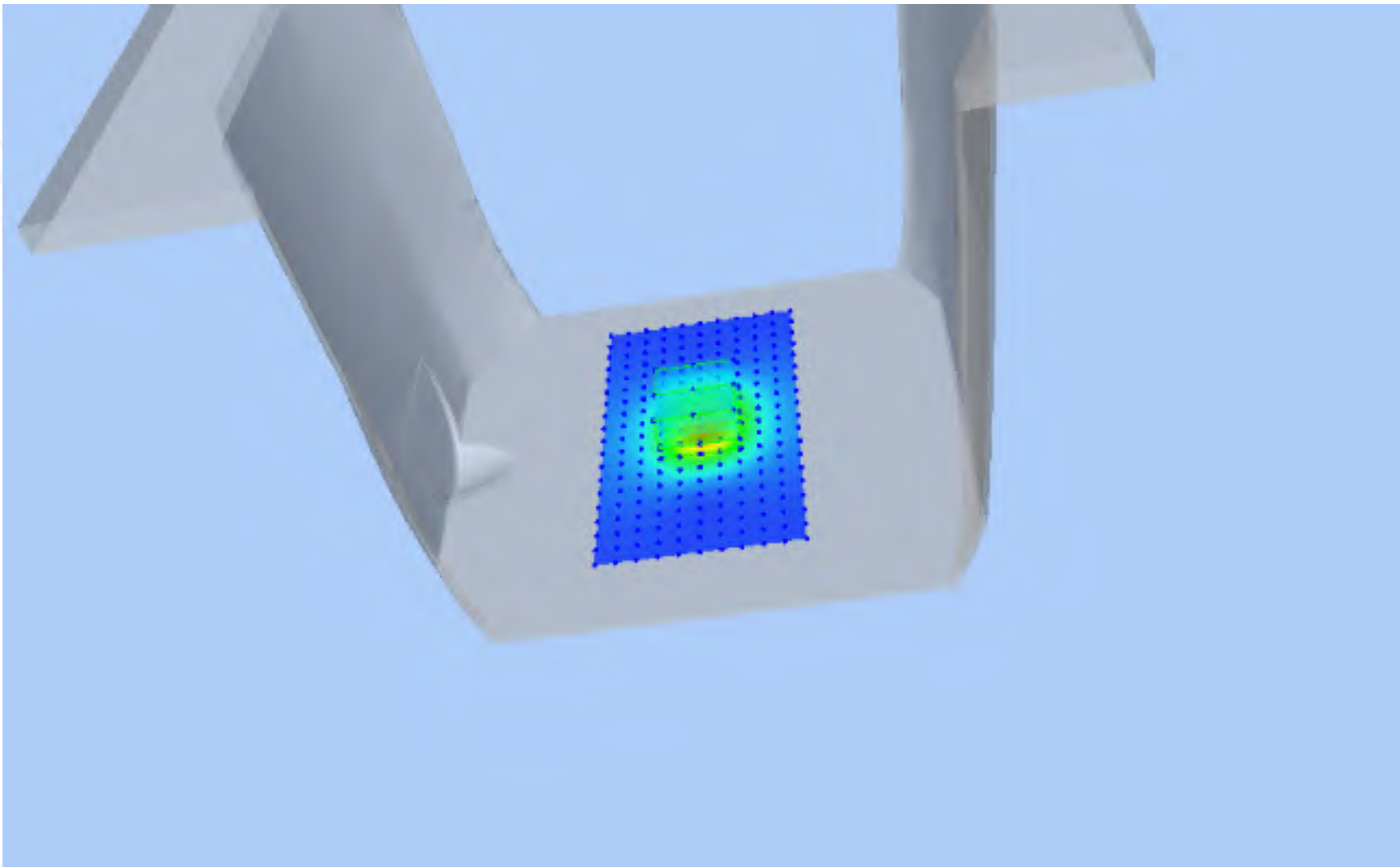
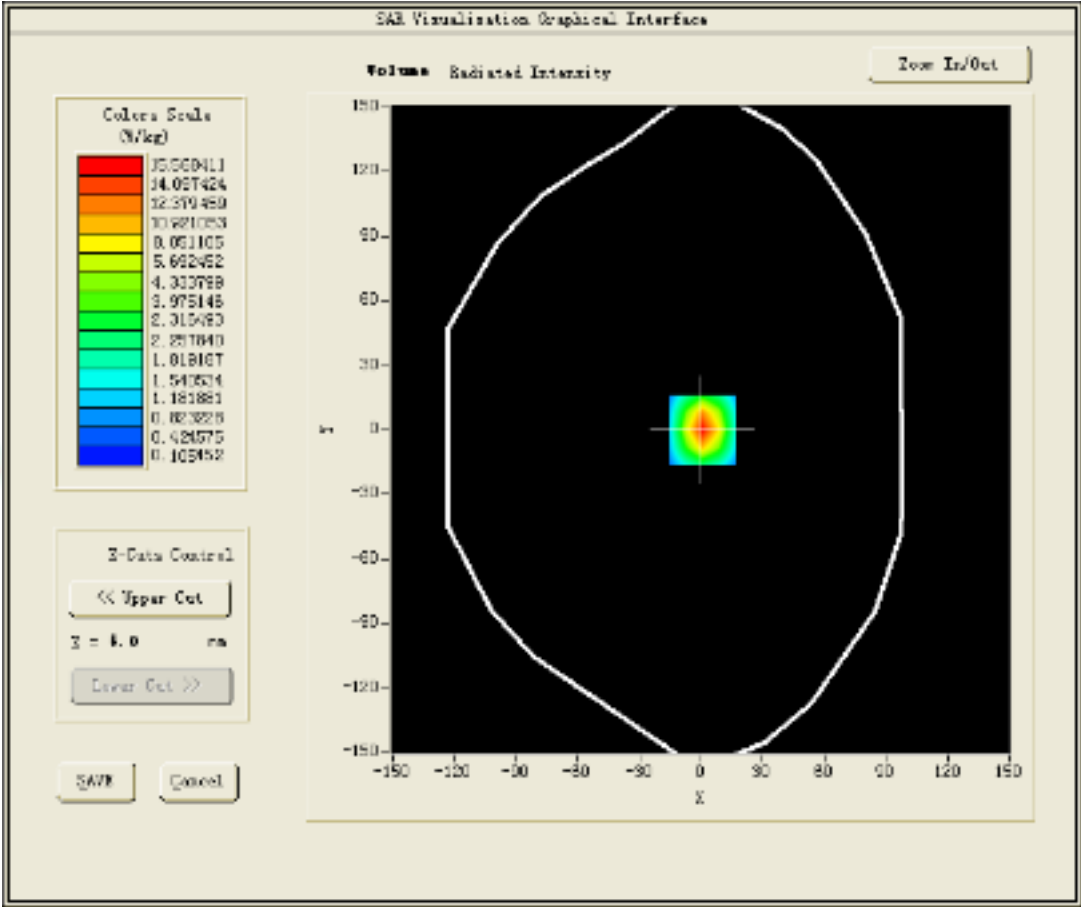
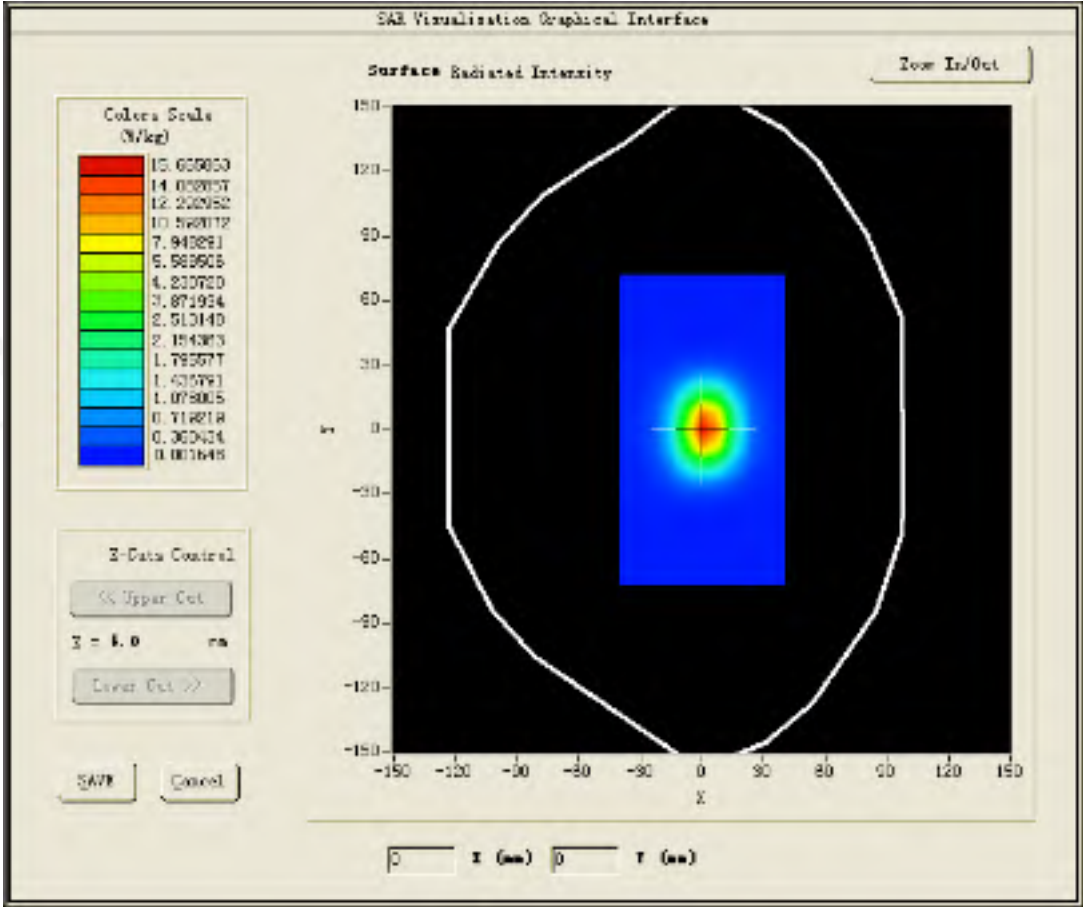
Medium(liquid type)	MSL_2450
Frequency (MHz)	2450.0000
Relative permittivity (real part)	52.55
Conductivity (S/m)	1.96
Input power	100mW
Crest Factor	1.0
Conversion Factor	2.70
Variation (%)	-1.630000
SAR 10g (W/Kg)	2.502463
SAR 1g (W/Kg)	5.450016
SURFACE SAR	VOLUME SAR





Test mode:5200MHz(Body)
Product Description:Validation
Model:Dipole SID5000
E-Field Probe: SSE2(SN 25/22 EPGO376)
Test Date: July 07, 2023

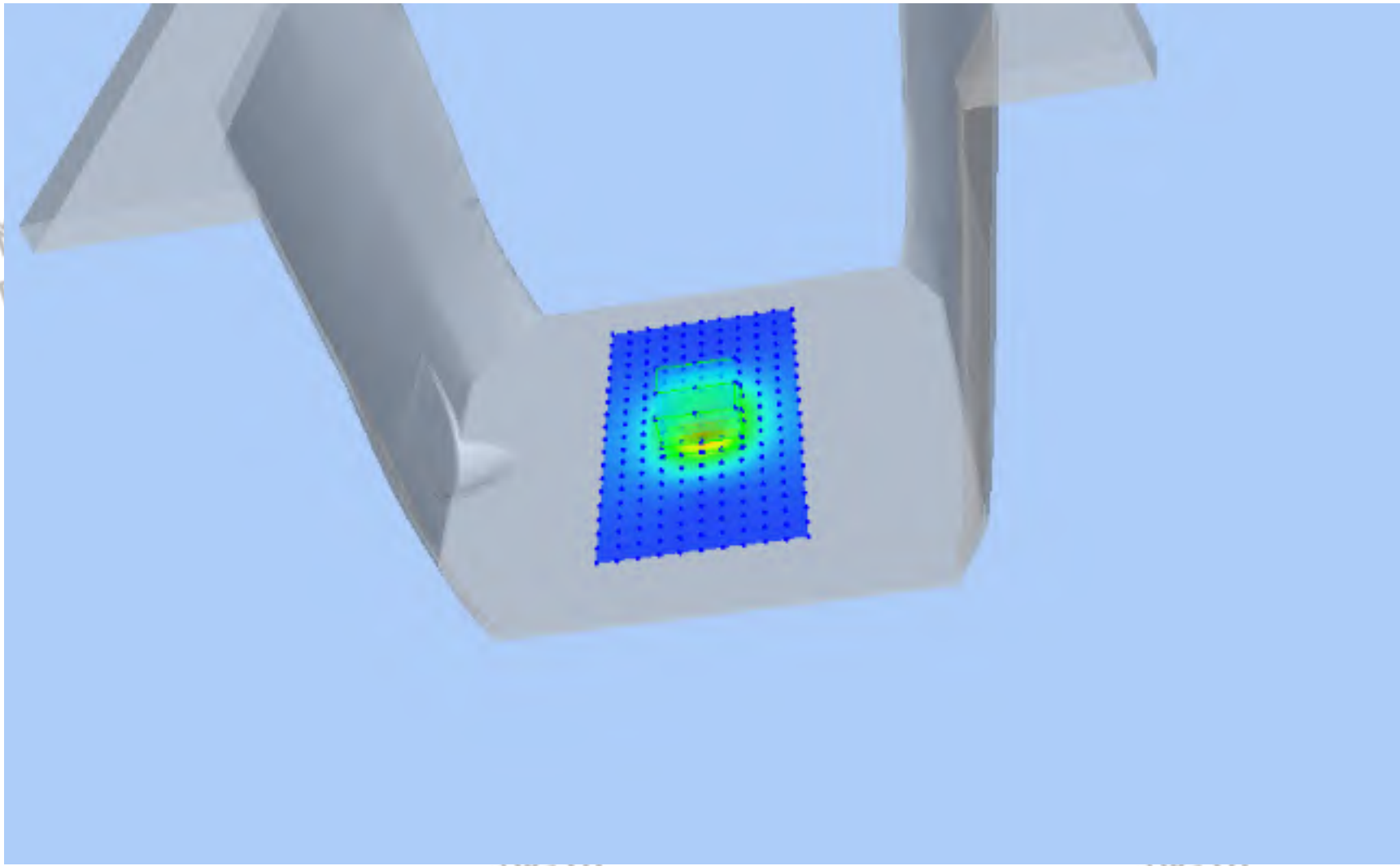
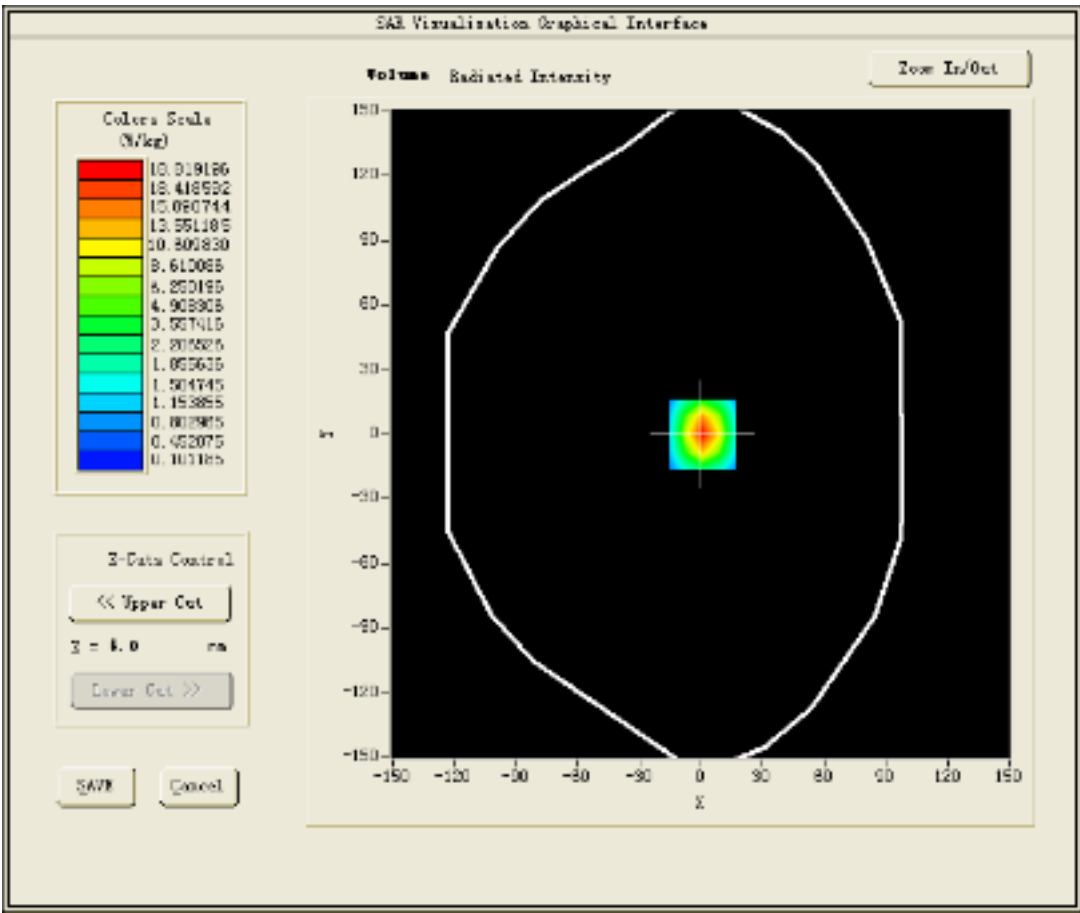
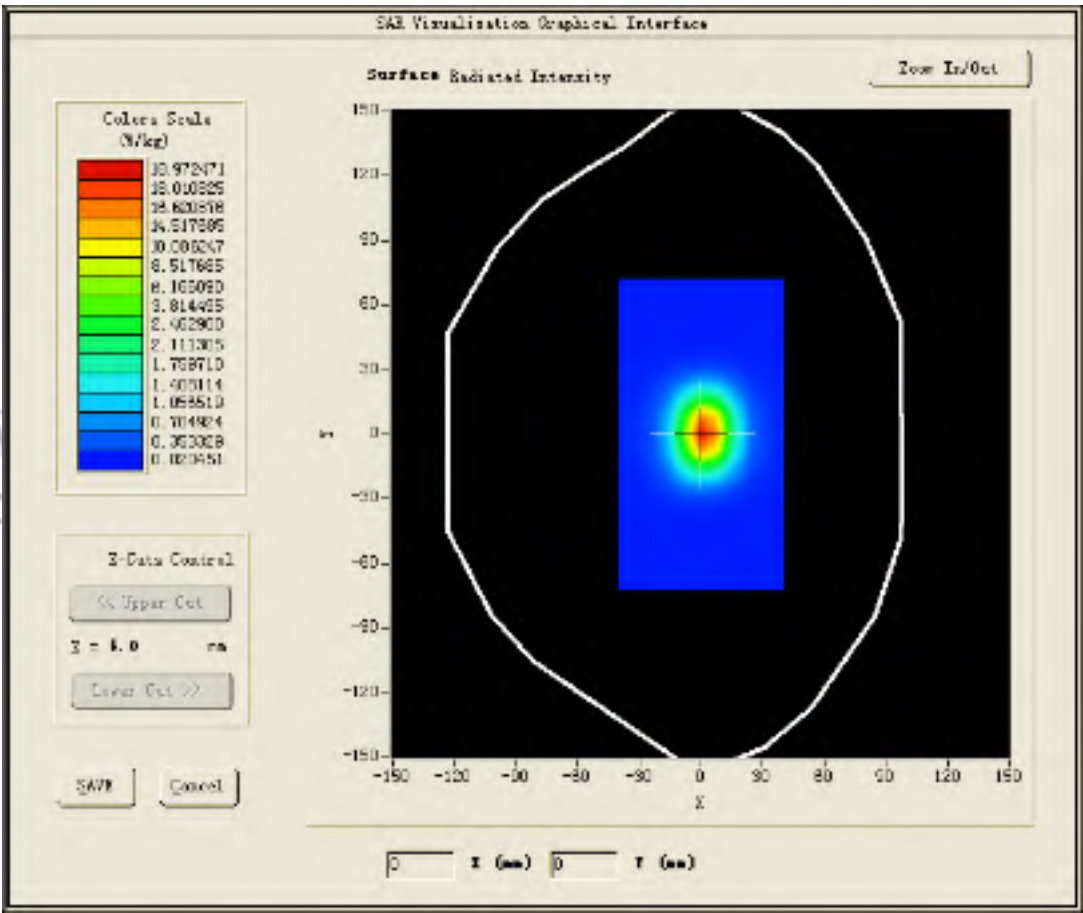
Medium(liquid type)	MSL_5000
Frequency (MHz)	5200.0000
Relative permittivity (real part)	49.21
Conductivity (S/m)	5.27
Input power	100mW
Crest Factor	1.0
Conversion Factor	1.81
Variation (%)	-0.650000
SAR 10g (W/Kg)	5.588210
SAR 1g (W/Kg)	15.687034
SURFACE SAR	VOLUME SAR





Test mode:5800MHz(Body)
Product Description:Validation
Model:Dipole SID5000
E-Field Probe: SSE2(SN 25/22 EPGO376)
Test Date: July 12, 2023

Medium(liquid type)	MSL_5000
Frequency (MHz)	5800.0000
Relative permittivity (real part)	48.05
Conductivity (S/m)	6.02
Input power	100mW
Crest Factor	1.0
Conversion Factor	1.97
Variation (%)	-4.820000
SAR 10g (W/Kg)	6.122085
SAR 1g (W/Kg)	18.200125
SURFACE SAR	VOLUME SAR



4.10. SAR Test Graph Results





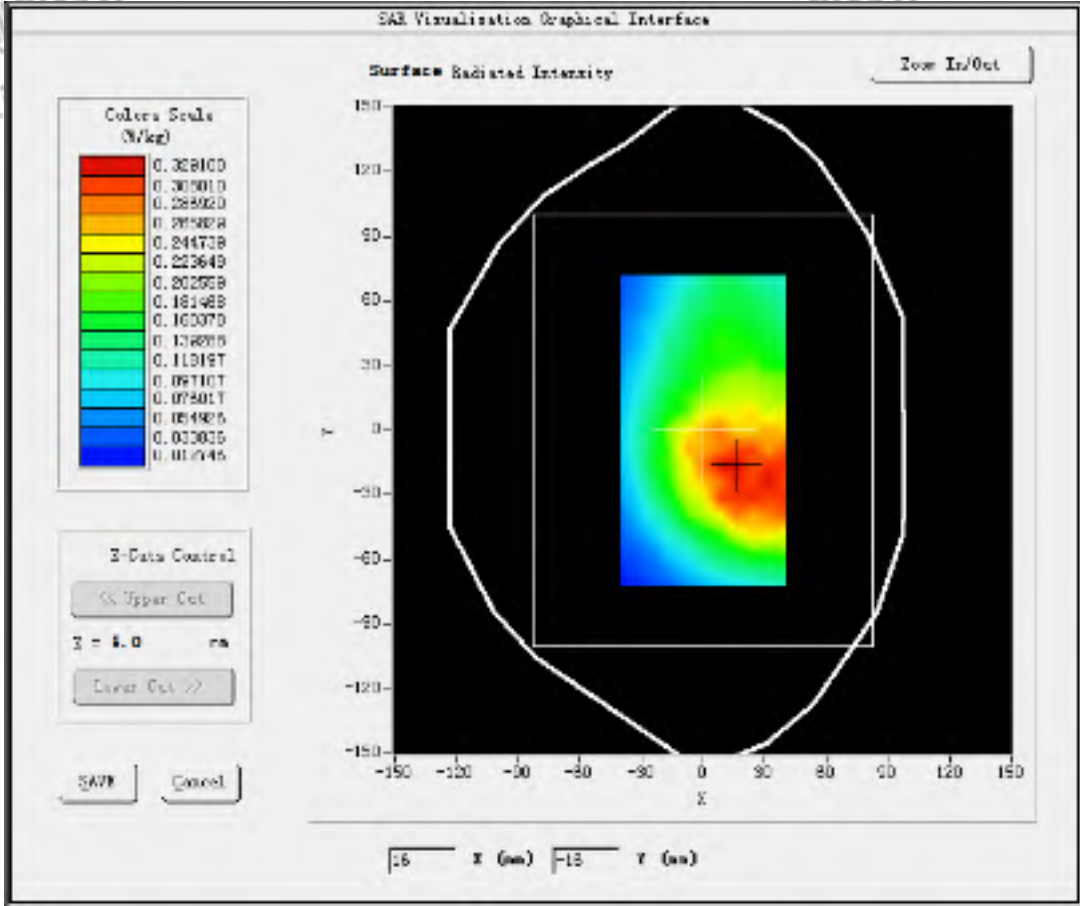
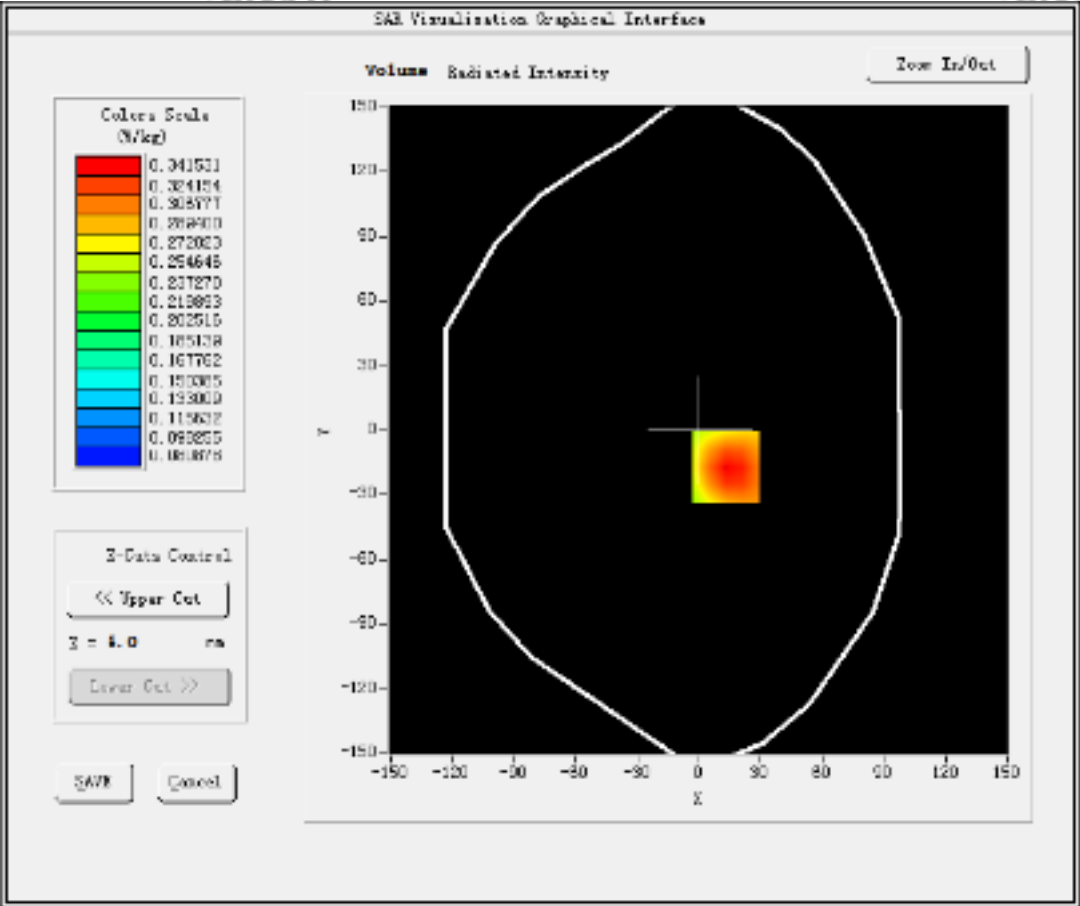
SAR plots for the highest measured SAR in each exposure configuration, wireless mode and frequency band combination

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

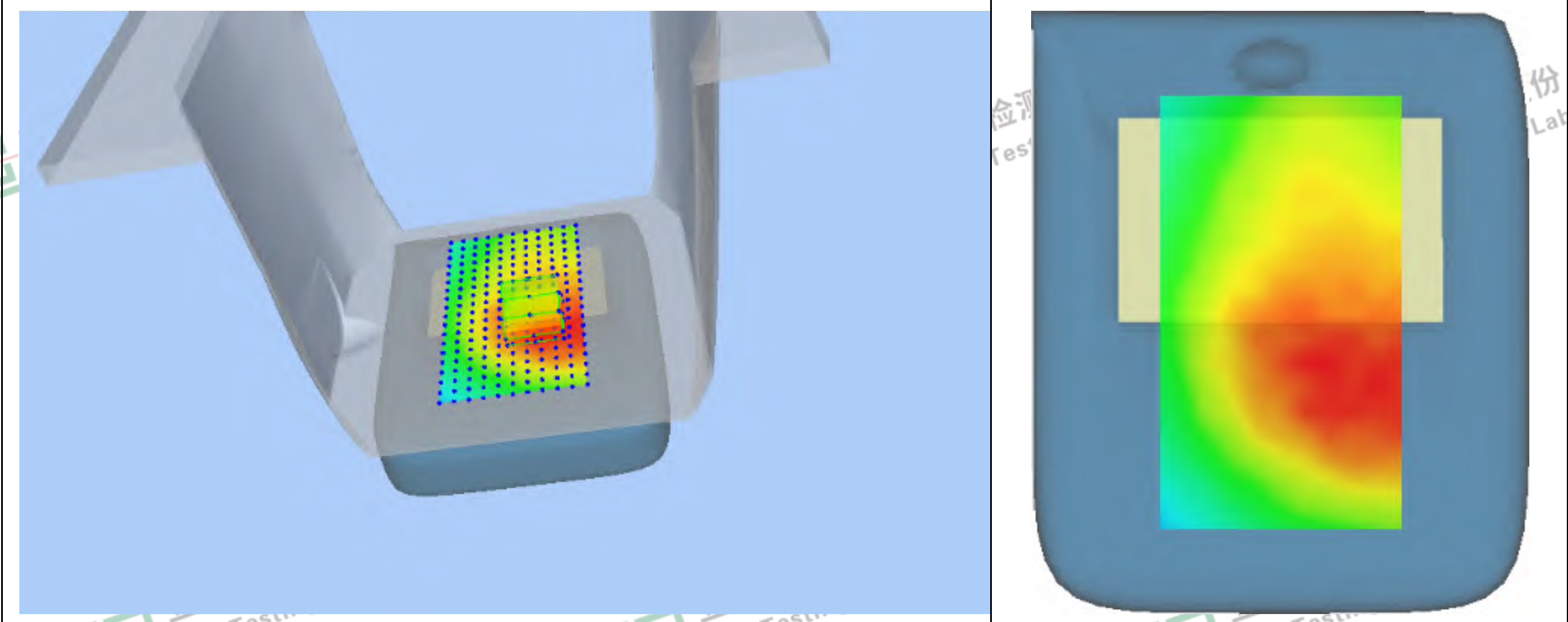
Product Description: Tablet PC

Model: VK-TM102-U

Test Date: June 22, 2023

Medium(liquid type)	MSL_835
Frequency (MHz)	824.2000
Relative permittivity (real part)	56.24
Conductivity (S/m)	0.93
E-Field Probe	SN 25/22 EPG0376
Crest Factor	2.0
Conversion Factor	1.80
Sensor	4mm
Area Scan	dx=8mmdy=8mm
Zoom Scan	5x5x7,dx=8mmdy=8mmdz=5mm
Variation (%)	0.370000
SAR 10g (W/Kg)	0.251198
SAR 1g (W/Kg)	0.332776
SURFACE SAR	VOLUME SAR
	



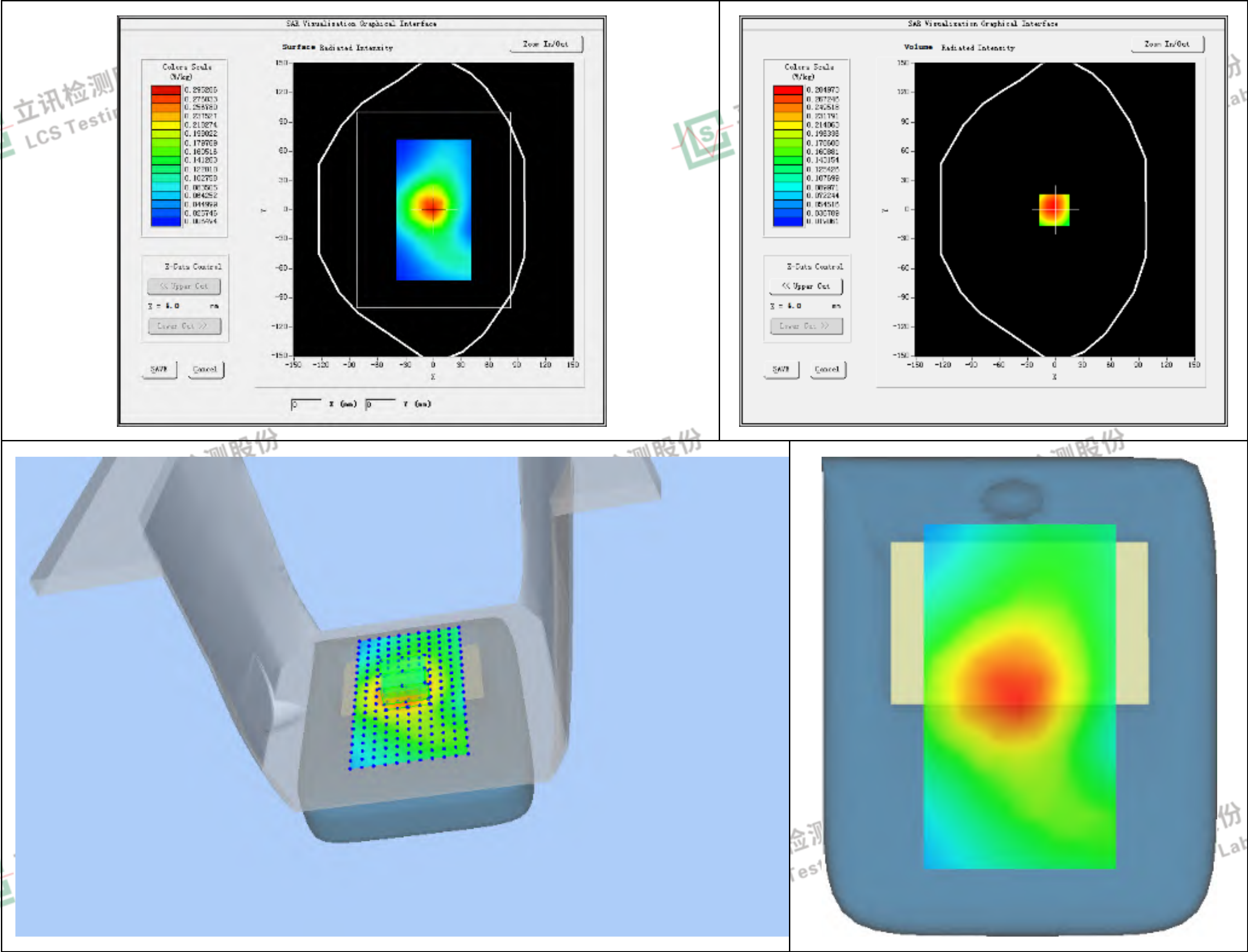


#2

Test Mode: GPRS1900MHz,High channel(Body Rear Side)
Product Description:Tablet PC
Model:VK-TM102-U
Test Date: June 29, 2023

Medium(liquid type)	MSL_1900
Frequency (MHz)	1909.8000
Relative permittivity (real part)	53.46
Conductivity (S/m)	1.51
E-Field Probe	SN25/22 EPG0376
CrestFactor	2.0
ConversionFactor	2.27
Sensor	4mm
Area Scan	dx=8mmdy=8mm
ZoomScan	5x5x7,dx=8mmdy=8mmdz=5mm
Variation (%)	2.240000
SAR 10g (W/Kg)	0.163225
SAR 1g (W/Kg)	0.274936
SURFACE SAR	VOLUME SAR



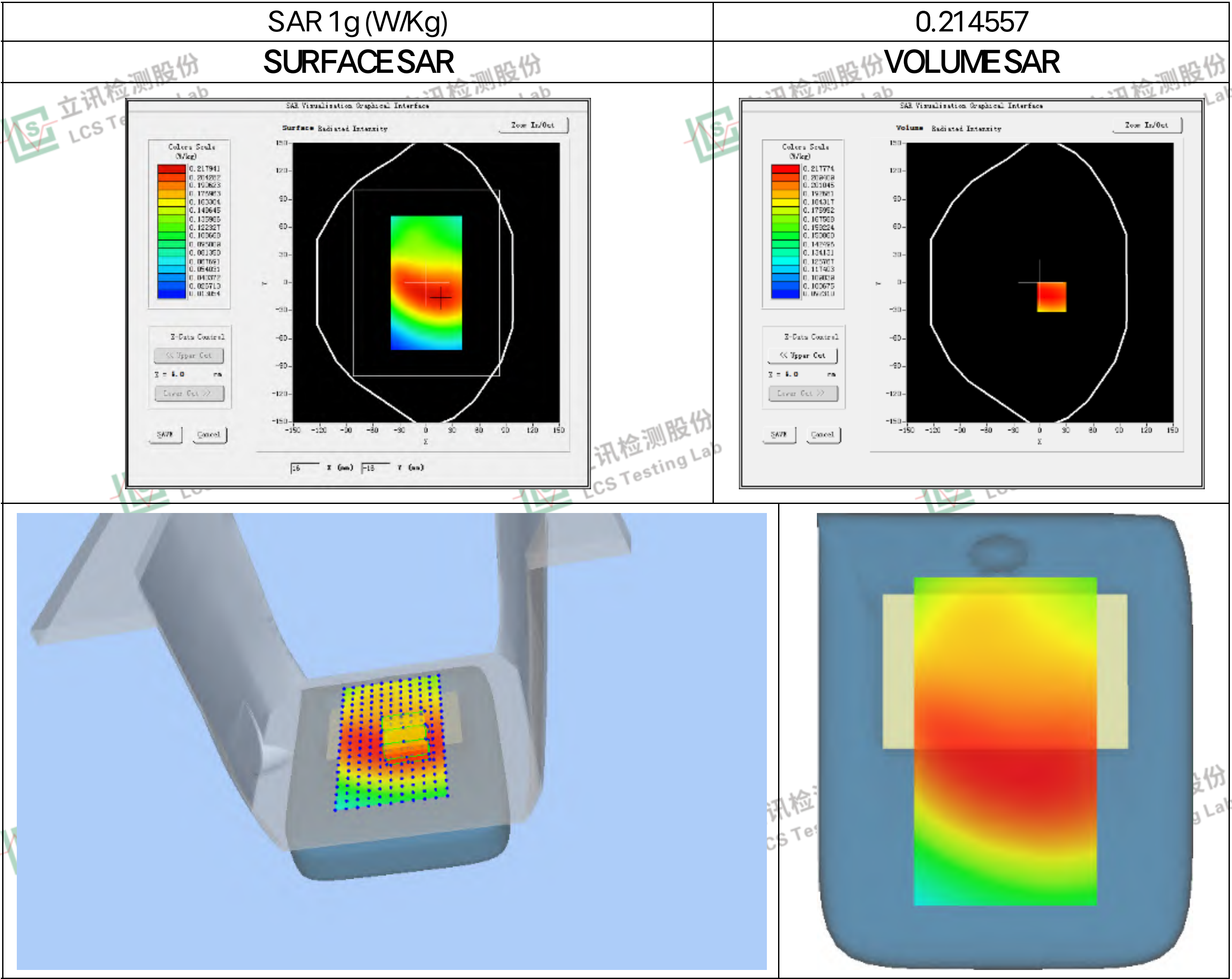


#3

Test Mode: WCDMA Band V, Low channel(Body Rear Side)
Product Description: Tablet PC
Model: VK-TM102-U
Test Date: June 26, 2023

Medium(liquid type)	MSL_835
Frequency (MHz)	826.4000
Relative permittivity (real part)	56.29
Conductivity (S/m)	0.93
E-Field Probe	SN25/22 EPG0376
Crest Factor	1.0
Conversion Factor	1.80
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7, dx=8mm dy=8mm dz=5mm
Variation (%)	0.530000
SAR 10g (W/Kg)	0.175168





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#4

Test Mode: WCDMA Band II, Middle channel(Body Rear Side)

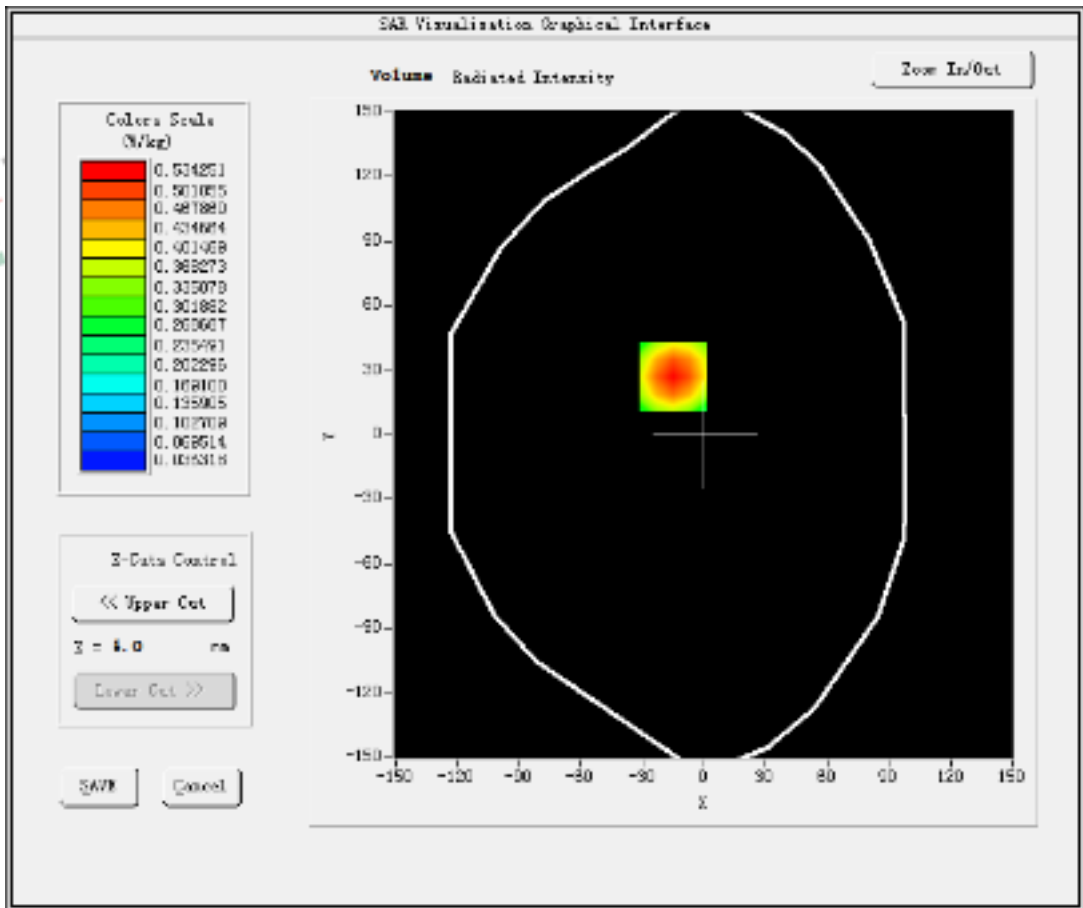
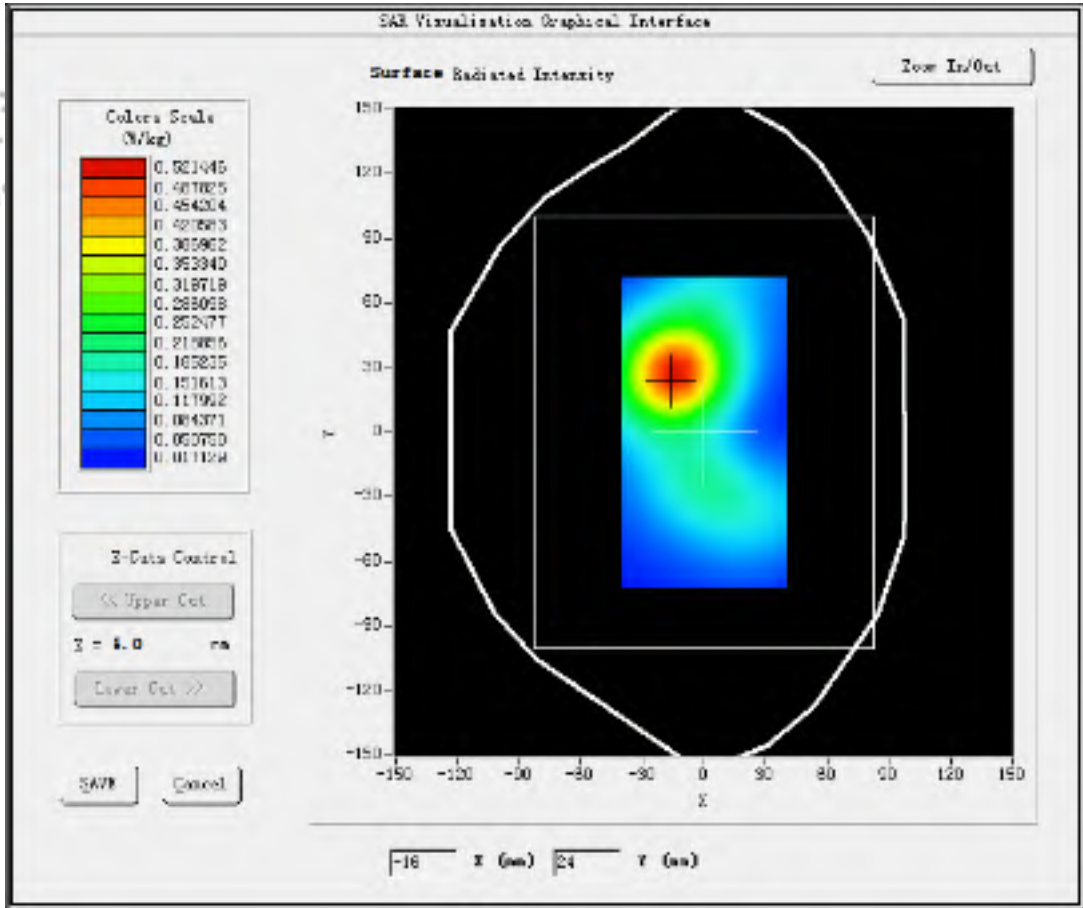
Product Description: Tablet PC

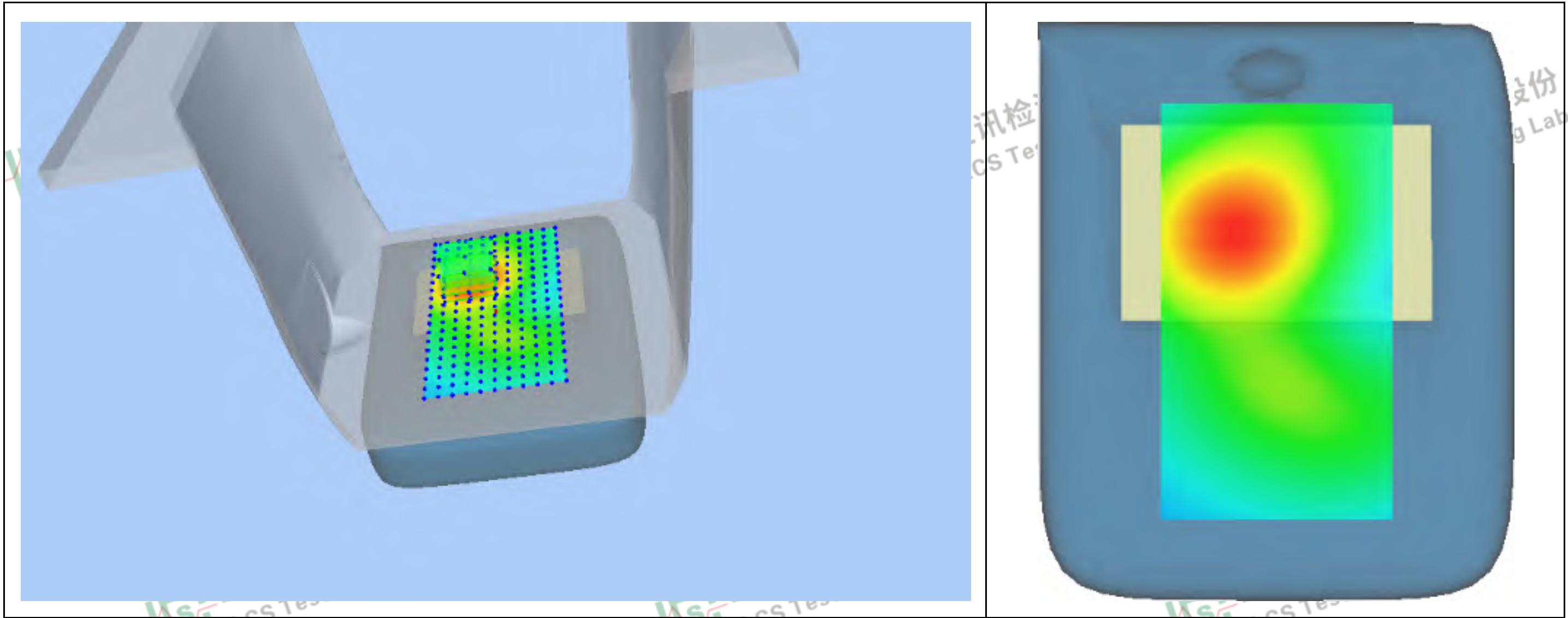
Model: VK-TM102-U

Test Date: June 29, 2023



Medium(liquidtype)	MSL_1900
Frequency (MHz)	1880.0000
Relative permittivity (real part)	53.46
Conductivity (S/m)	1.51
E-FieldProbe	SN 25/22 EPGO376
CrestFactor	1.0
Conversion Factor	2.27
Sensor	4mm
Area Scan	dx=8mmdy=8mm
Zoom Scan	5x5x7,dx=8mmdy=8mmdz=5mm
Variation (%)	-1.590000
SAR 10g (W/Kg)	0.300993
SAR 1g (W/Kg)	0.504627
SURFACE SAR	VOLUME SAR





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#5

Test Mode: LTE Band 2, 1RB,High channel(Body Rear Side)

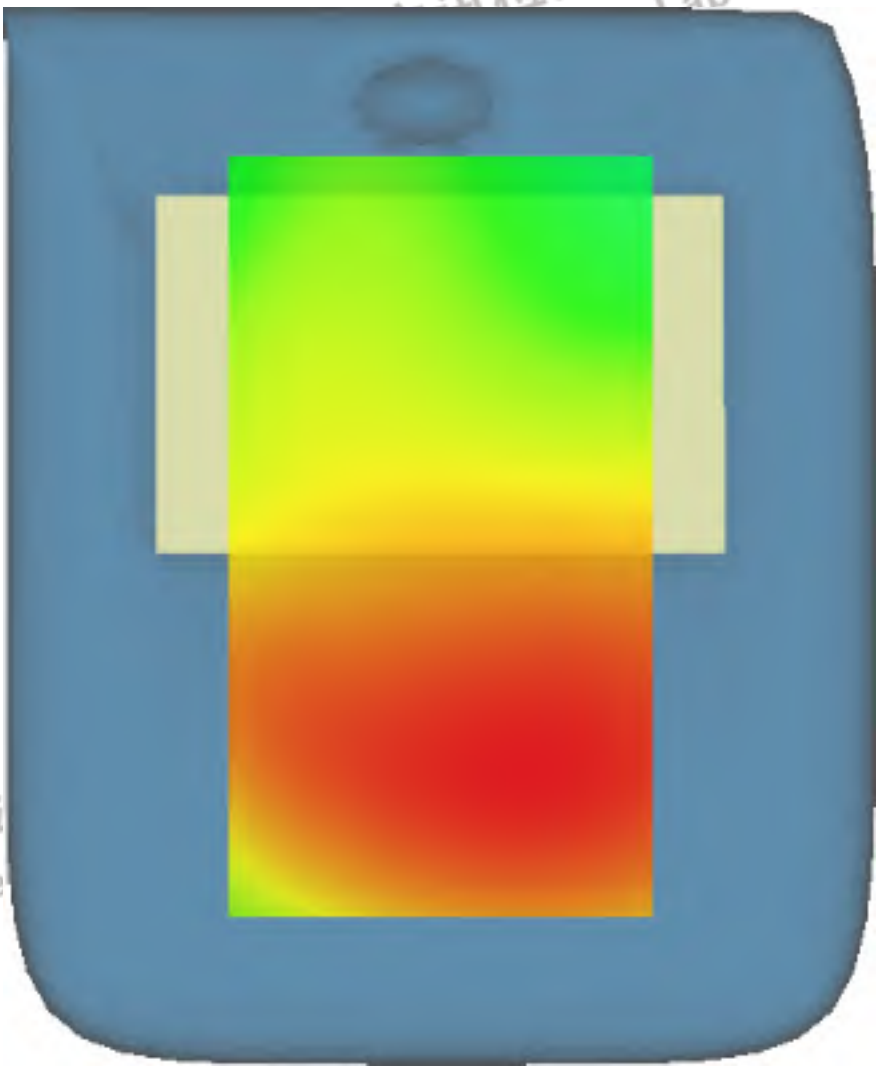
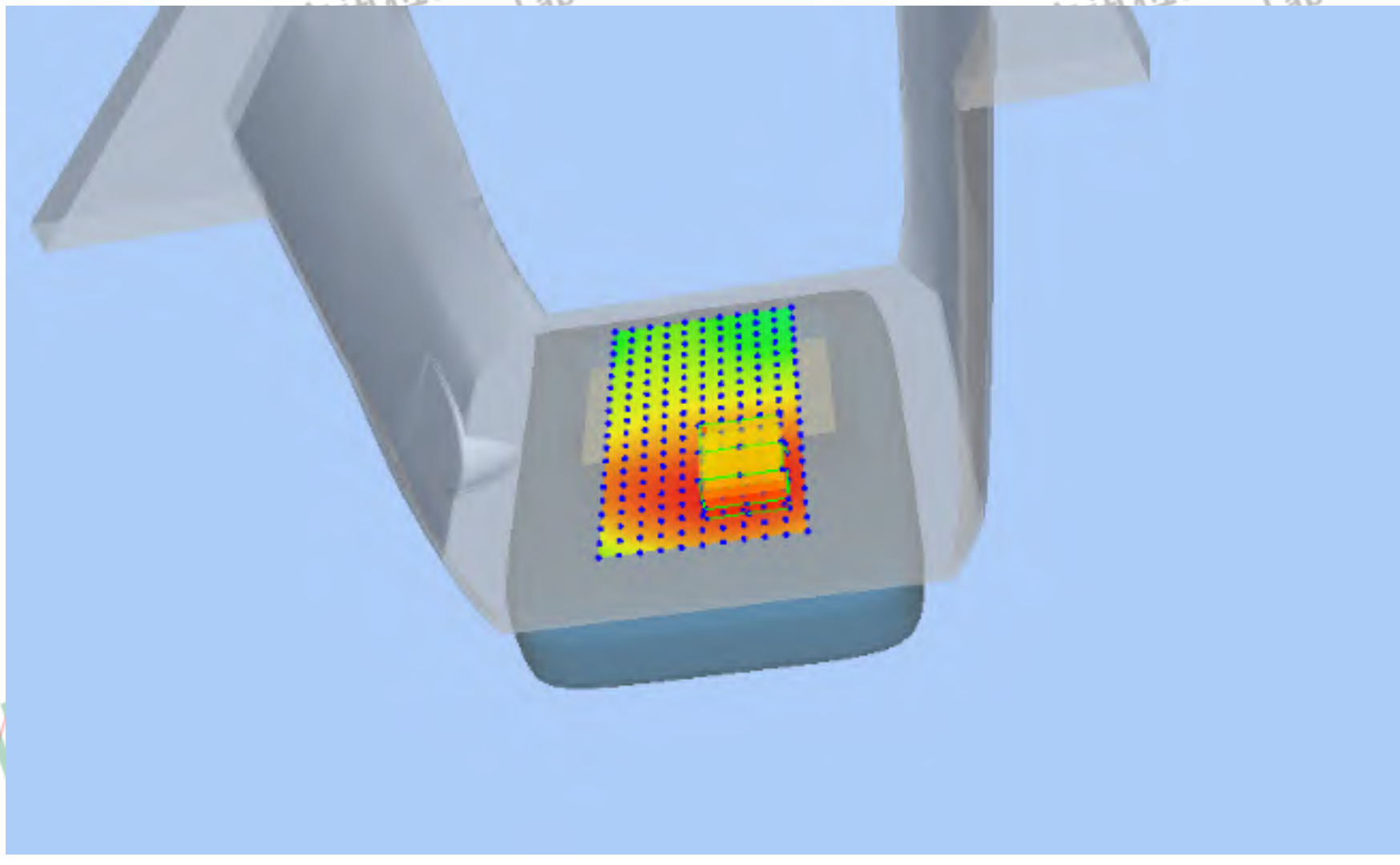
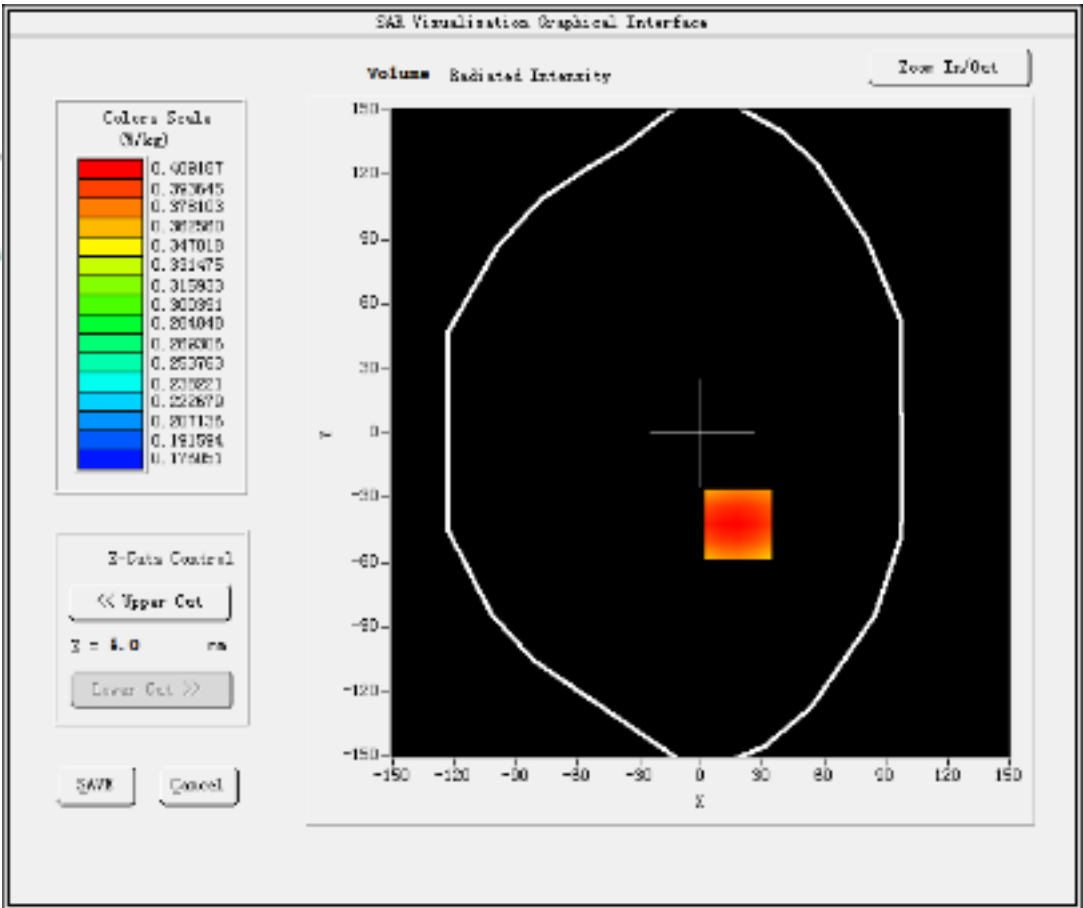
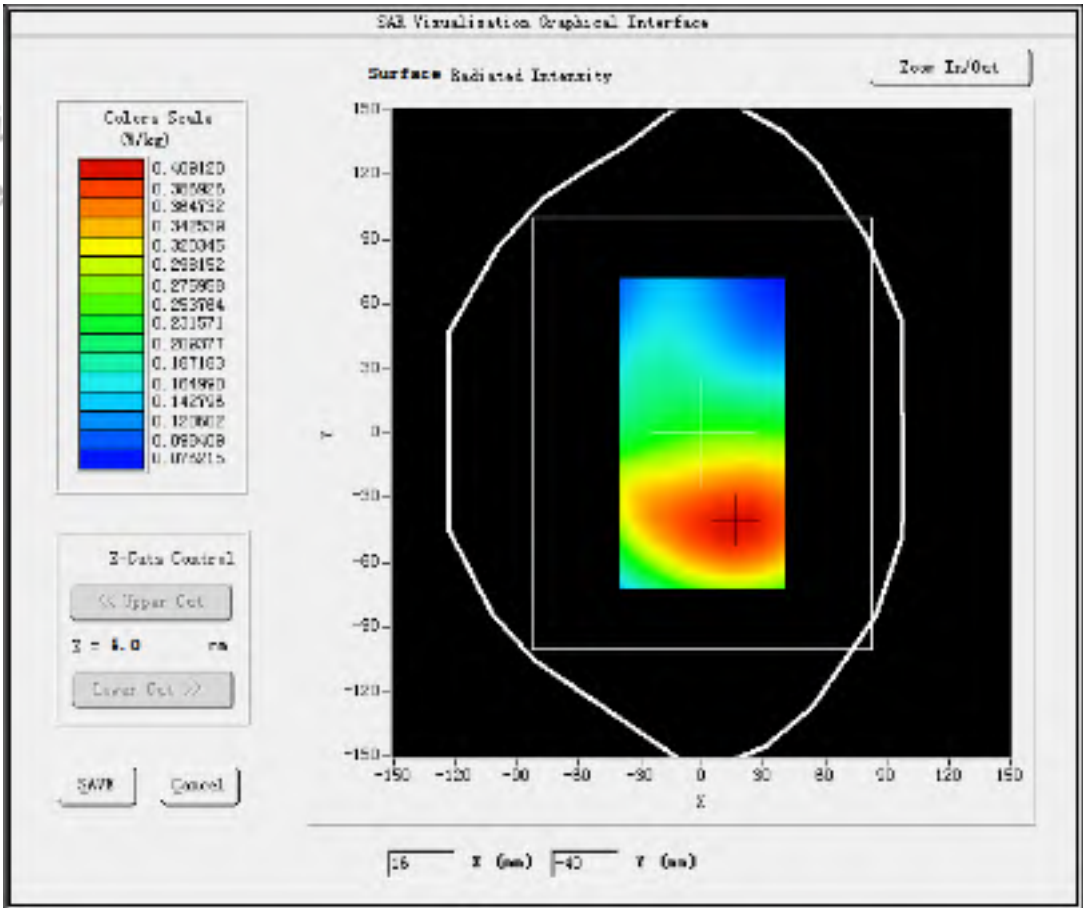
Product Description:Tablet PC

Model:VK-TM102-U

Test Date: June 29, 2023



Medium(liquid type)	MSL_1900
Frequency (MHz)	1900.0000
Relative permittivity (real part)	53.46
Conductivity (S/m)	1.51
E-Field Probe	SN25/22 EPGO376
Crest Factor	1.0
Conversion Factor	2.27
Sensor	4mm
Area Scan	dx=8mmdy=8mm
Zoom Scan	5x5x7,dx=8mmdy=8mmdz=5mm
Variation (%)	-0.820000
SAR 10g (W/Kg)	0.344274
SAR 1g (W/Kg)	0.432776
SURFACE SAR	VOLUME SAR







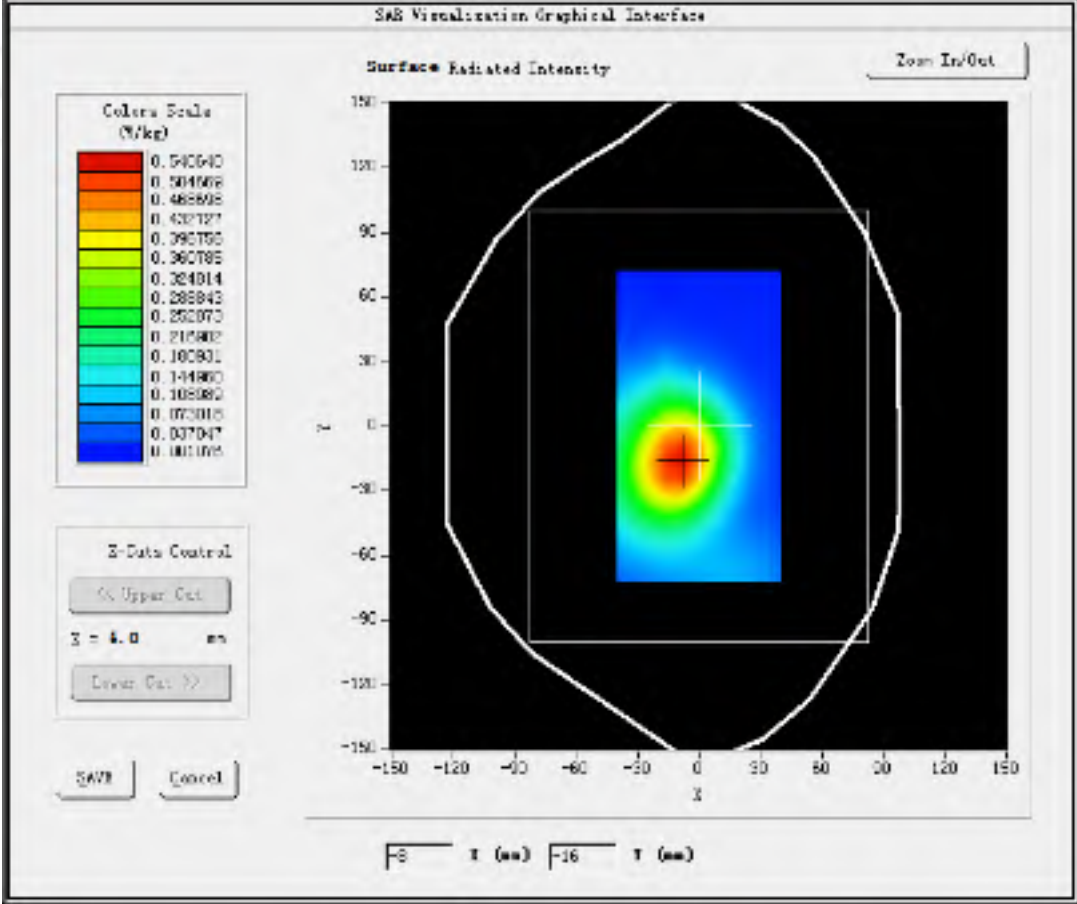
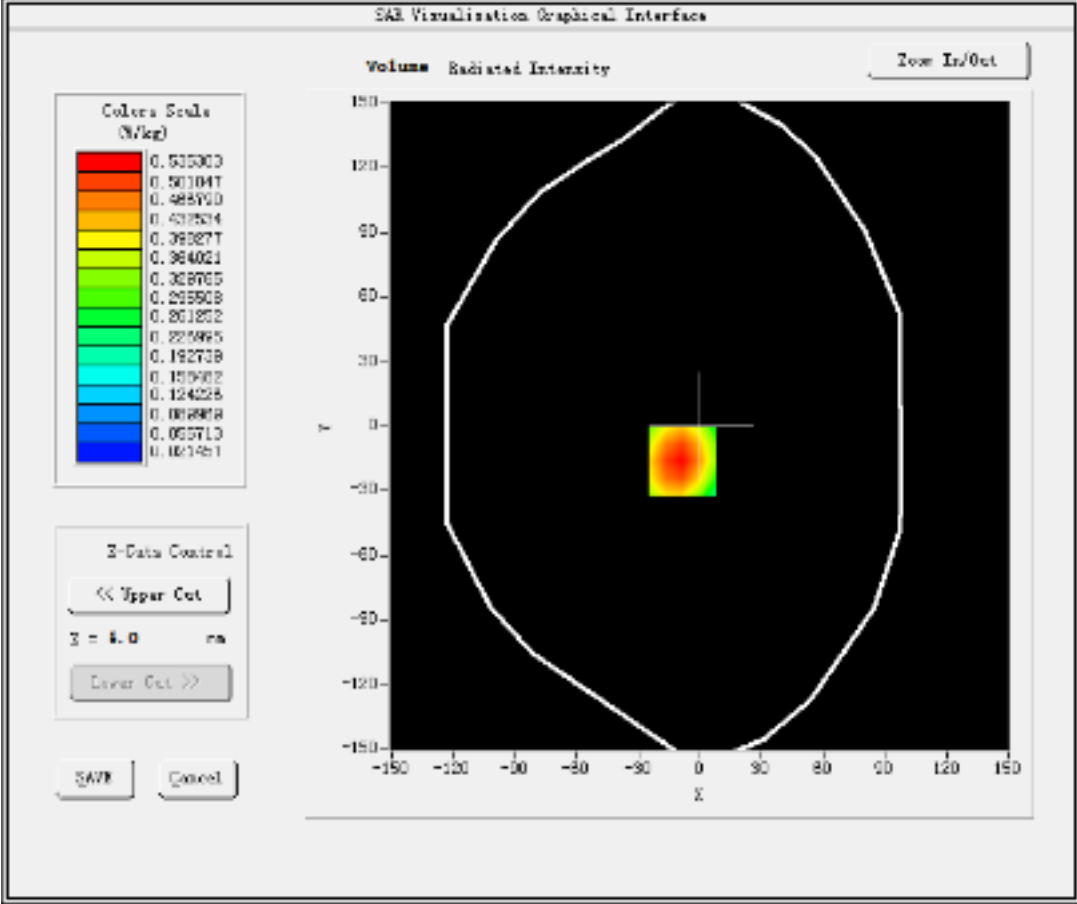
#6

Test Mode: LTE Band 4, 1RB, Low channel(Body Rear Side)

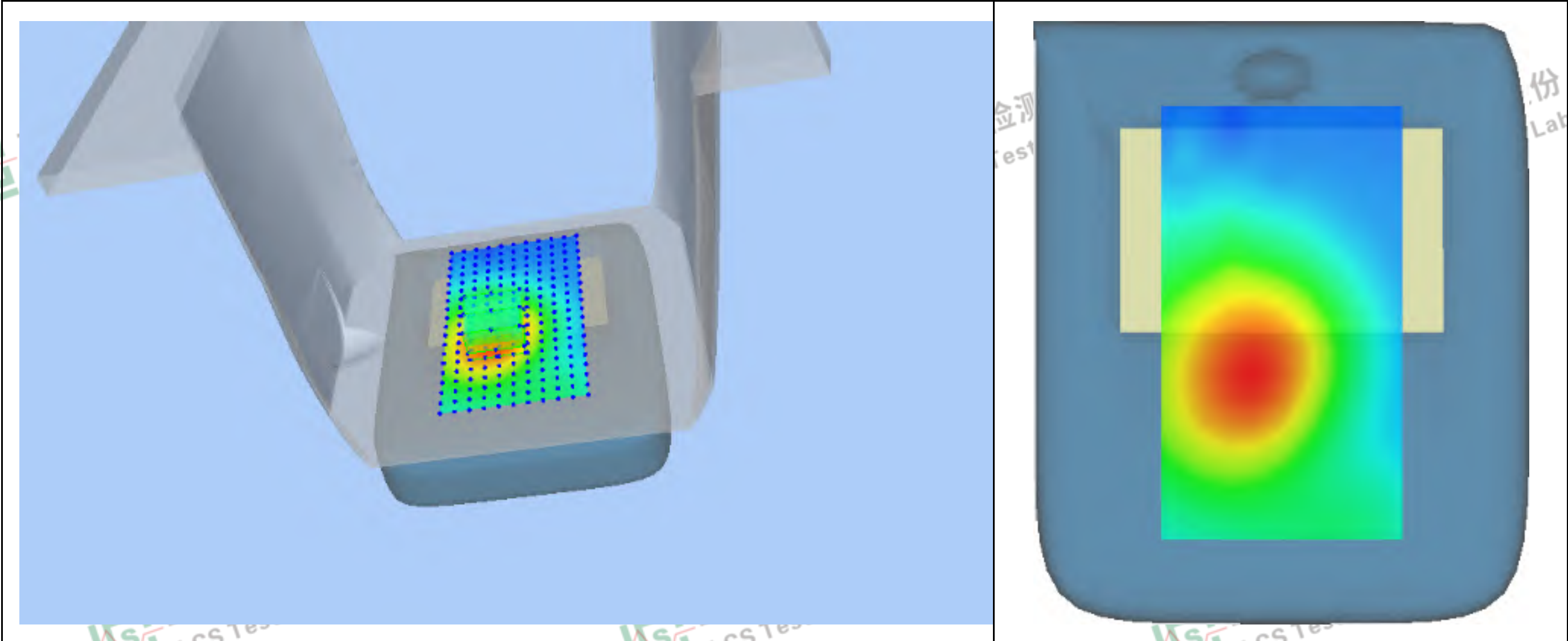
Product Description: Tablet PC

Model: VK-TM102-U

Test Date: June 28, 2023

Medium(liquid type)	MSL_1800
Frequency (MHz)	1720.0000
Relative permittivity (real part)	55.23
Conductivity (S/m)	1.52
E-Field Probe	SN 25/22 EPG0376
Crest Factor	1.0
Conversion Factor	2.15
Sensor	4mm
Area Scan	dx=8mmdy=8mm
Zoom Scan	5x5x7,dx=8mmdy=8mmdz=5mm
Variation (%)	0.530000
SAR 10g (W/Kg)	0.284890
SAR 1g (W/Kg)	0.508215
SURFACE SAR	VOLUME SAR
	





#7

Test Mode: LTE Band 5, 1RB, Middle channel(Body Rear Side)

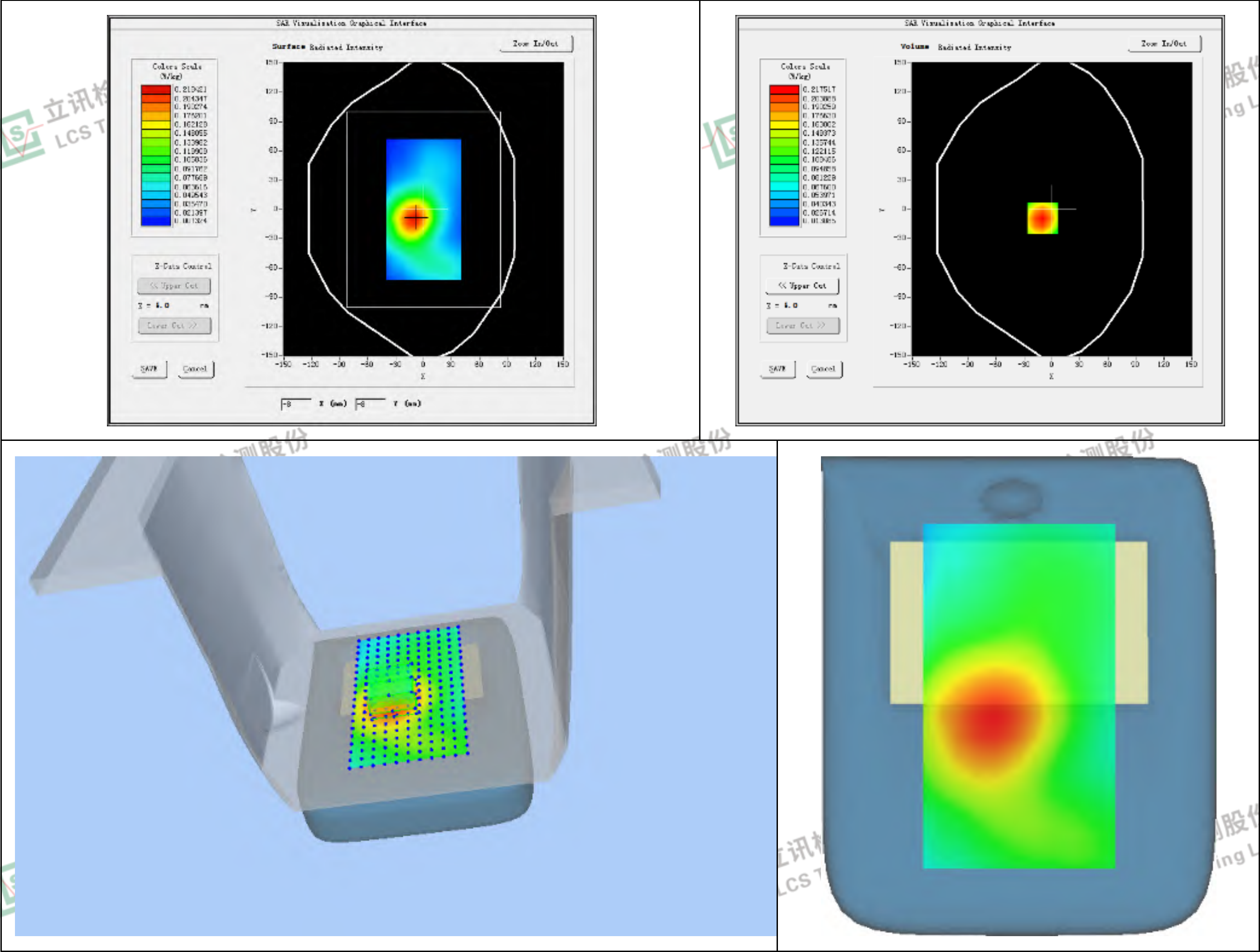
Product Description:Tablet PC

Model:VK-TM102-U

Test Date: June 26, 2023

Medium(liquid type)	MSL_835
Frequency (MHz)	836.5000
Relative permittivity (real part)	56.29
Conductivity (S/m)	0.93
E-Field Probe	SN 25/22 EPG0376
Crest Factor	1.0
Conversion Factor	1.80
Sensor	4mm
Area Scan	dx=8mmdy=8mm
Zoom Scan	5x5x7,dx=8mmdy=8mmdz=5mm
Variation (%)	-0.790000
SAR 10g (W/Kg)	0.127680
SAR 1g (W/Kg)	0.212871
SURFACE SAR	VOLUME SAR





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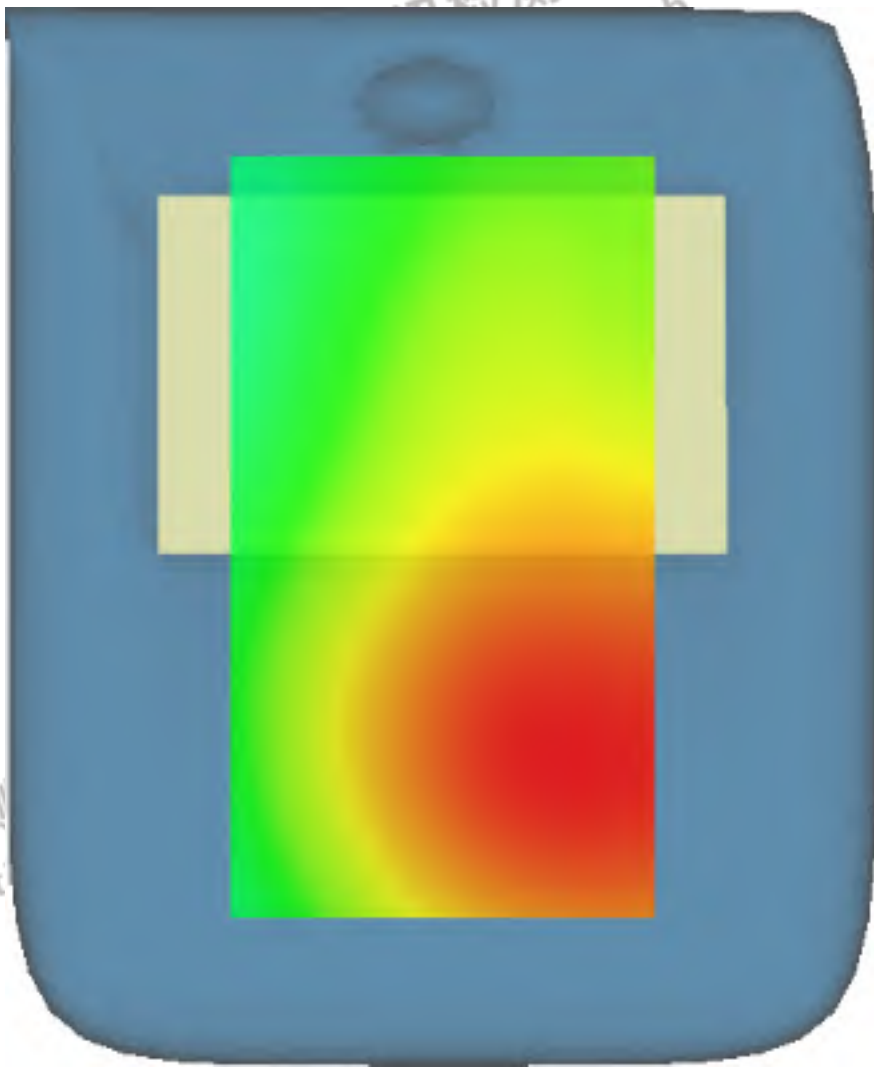
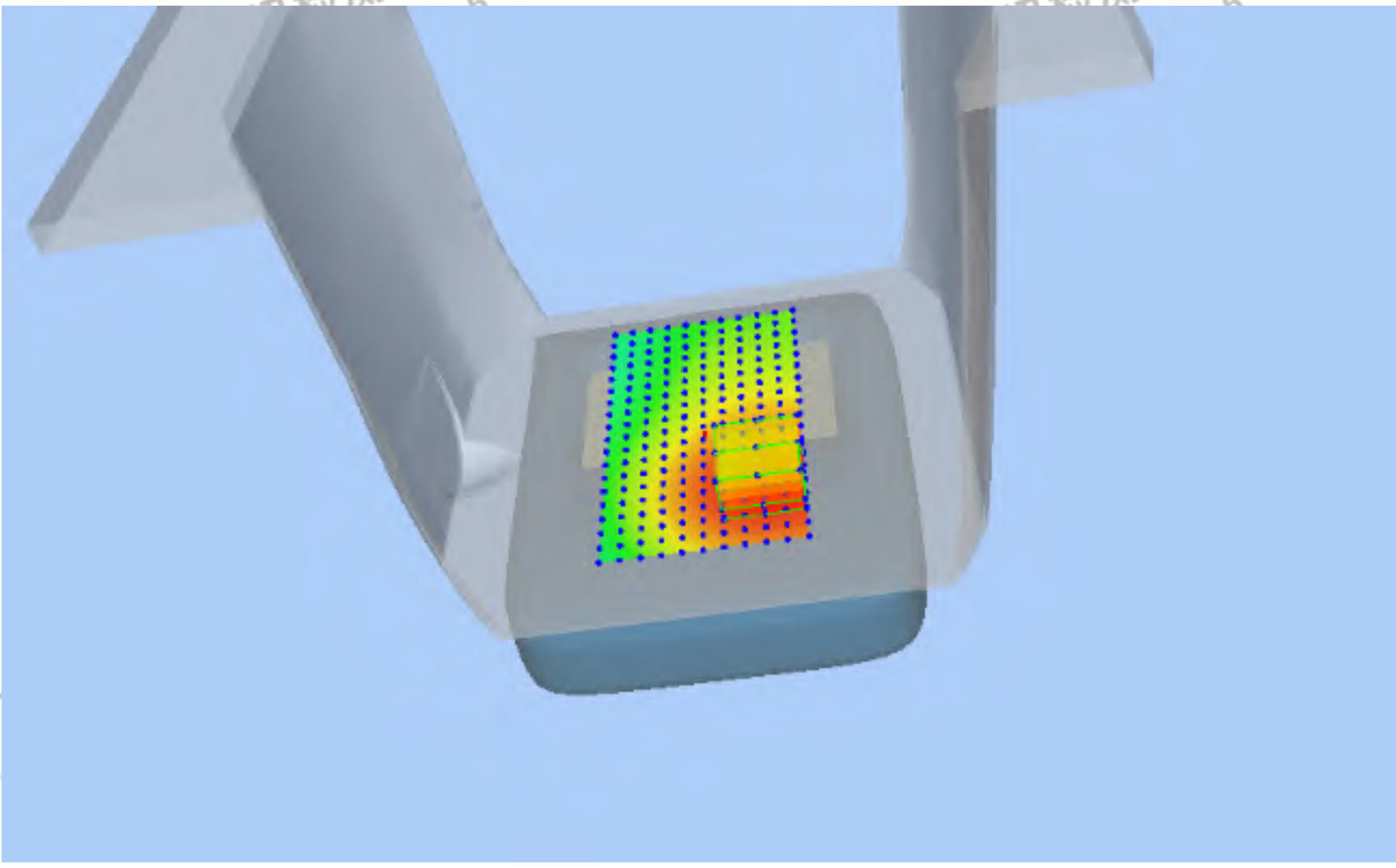
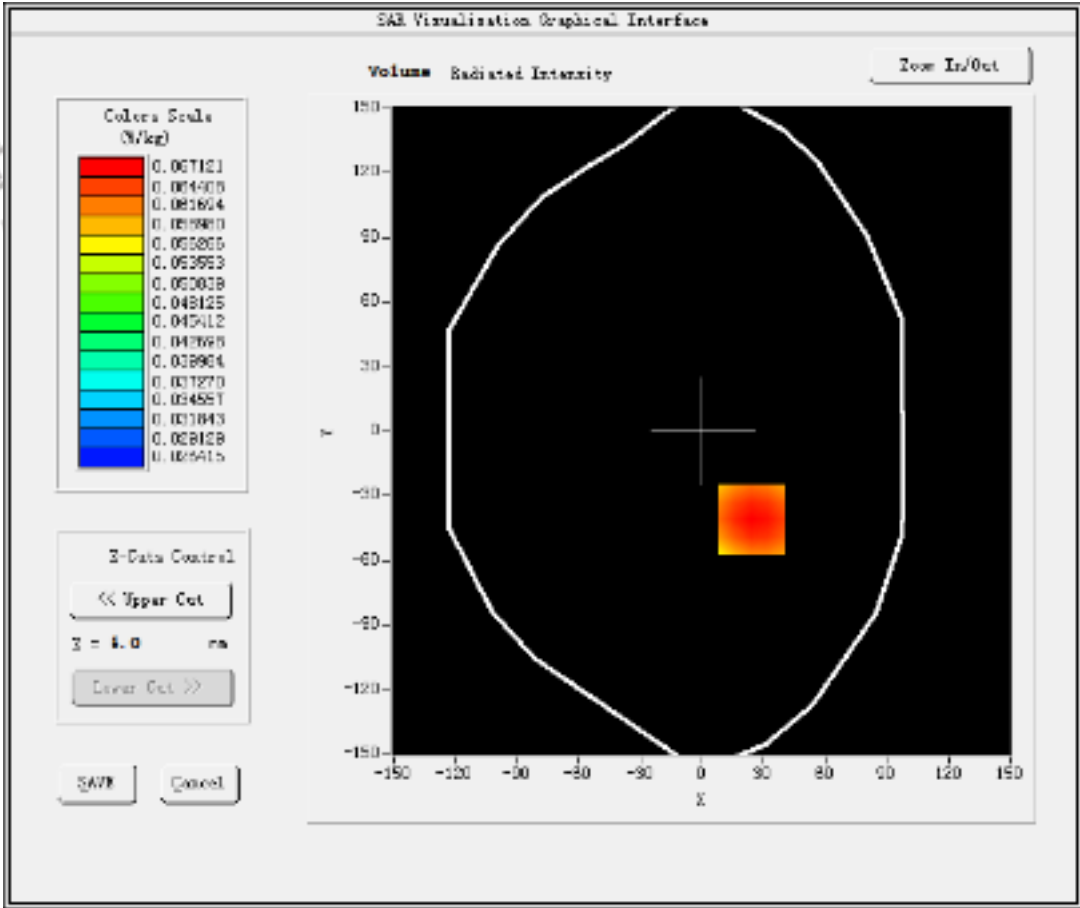
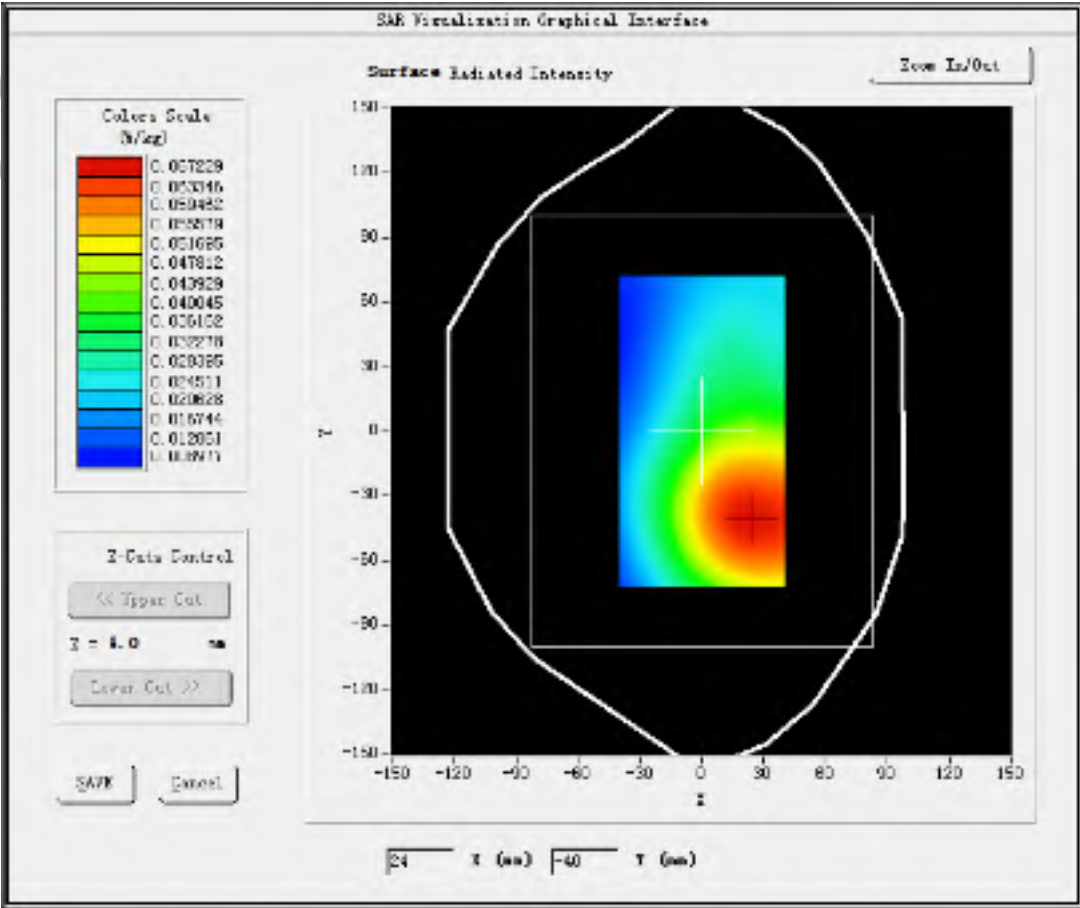




#8

Test Mode: LTE Band 12, 1RB, Low channel (Body Rear Side)
Product Description: Tablet PC
Model: VK-TM102-U
Test Date: June 22, 2023

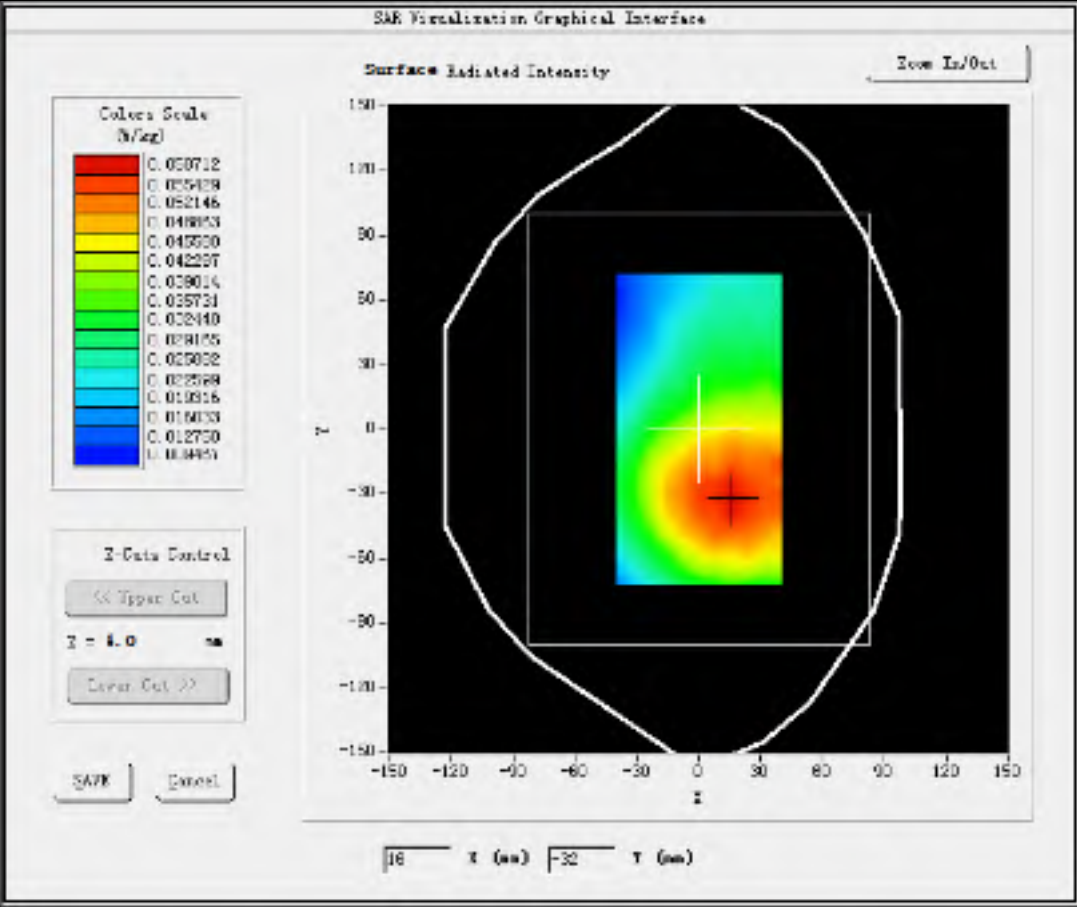
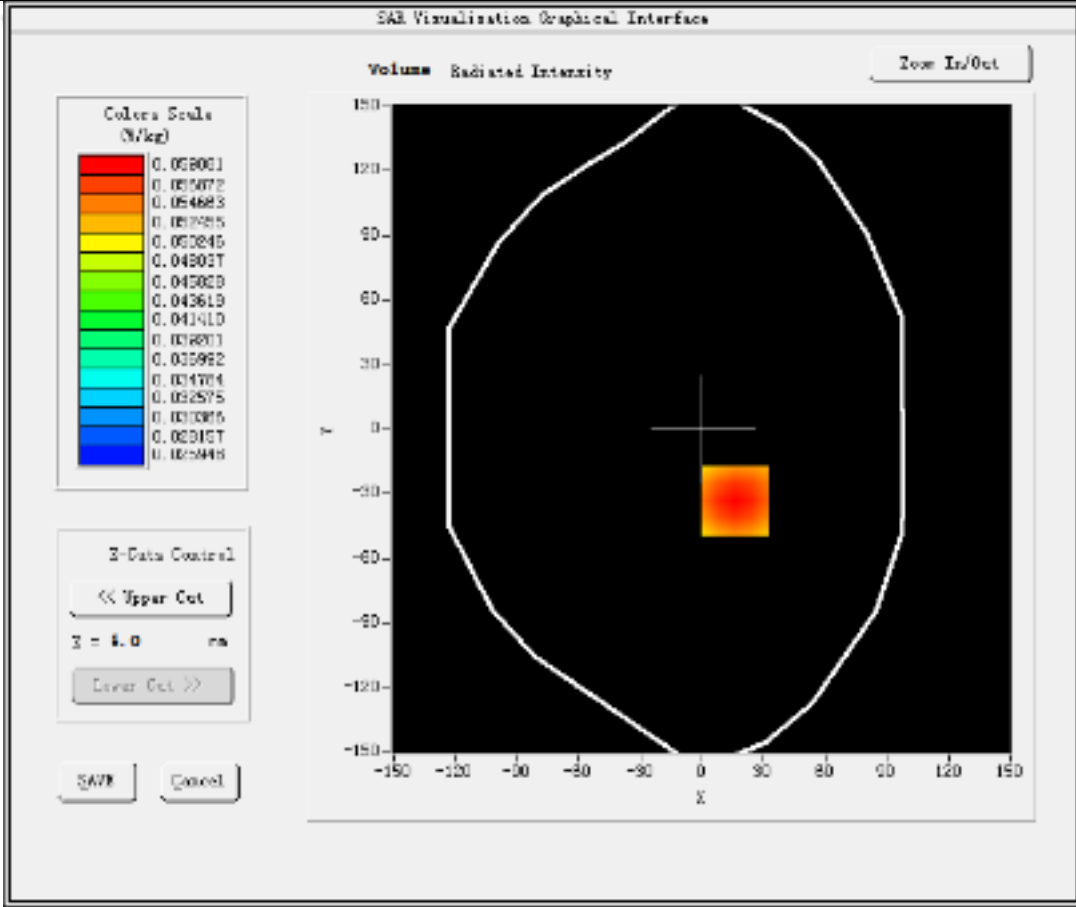
Medium(liquid type)	MSL_750
Frequency (MHz)	704.0000
Relative permittivity (real part)	55.82
Conductivity (S/m)	0.92
E-Field Probe	SN25/22 EPGO376
Crest Factor	1.0
Conversion Factor	1.73
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7, dx=8mm dy=8mm dz=5mm
Variation (%)	-2.110000
SAR 10g (W/Kg)	0.055972
SAR 1g (W/Kg)	0.069164
SURFACE SAR	VOLUME SAR



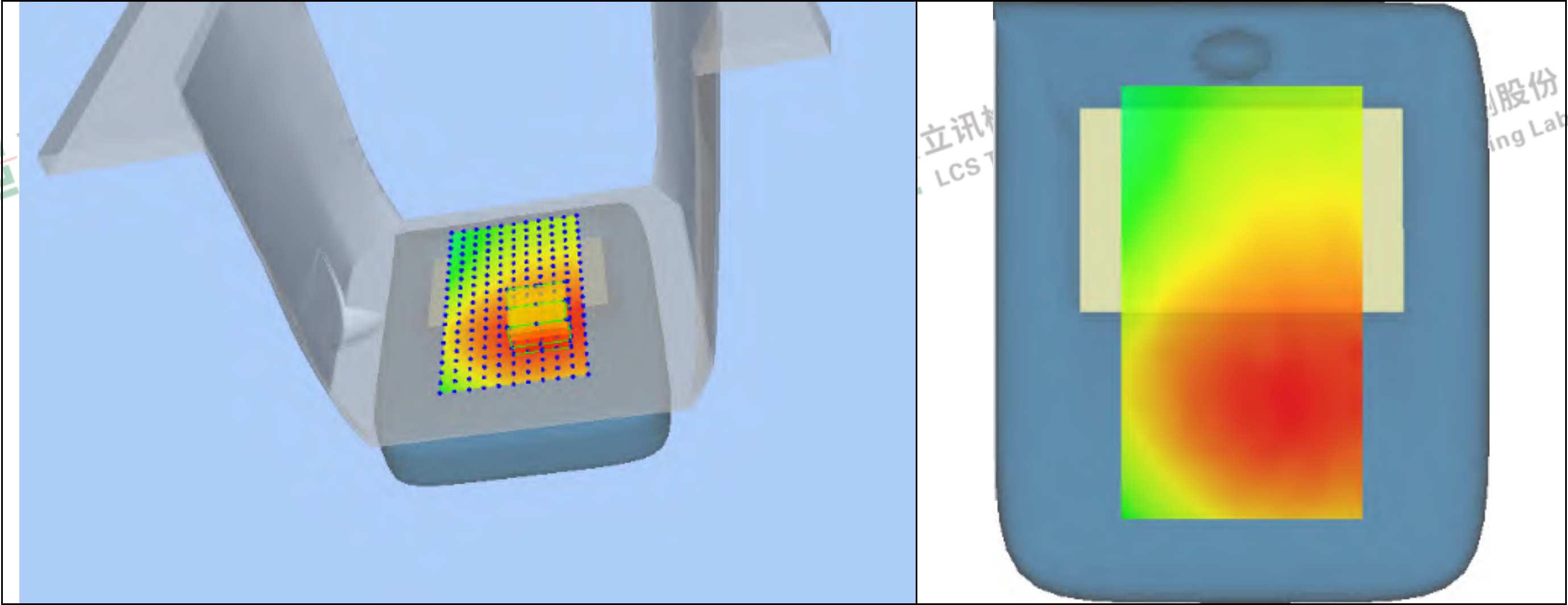


#9

Test Mode: LTE Band 17, 1RB, Middle channel (Body Rear Side)
Product Description: Tablet PC
Model: VK-TM1 02-U
Test Date: June 22, 2023

Medium(liquid type)	MSL_750
Frequency (MHz)	710.0000
Relative permittivity (real part)	55.82
Conductivity (S/m)	0.92
E-Field Probe	SN 25/22 EPG0376
Crest Factor	1.0
Conversion Factor	1.73
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7, dx=8mm dy=8mm dz=5mm
Variation (%)	1.530000
SAR 10g (W/Kg)	0.050283
SAR 1g (W/Kg)	0.061223
SURFACE SAR	VOLUME SAR
	





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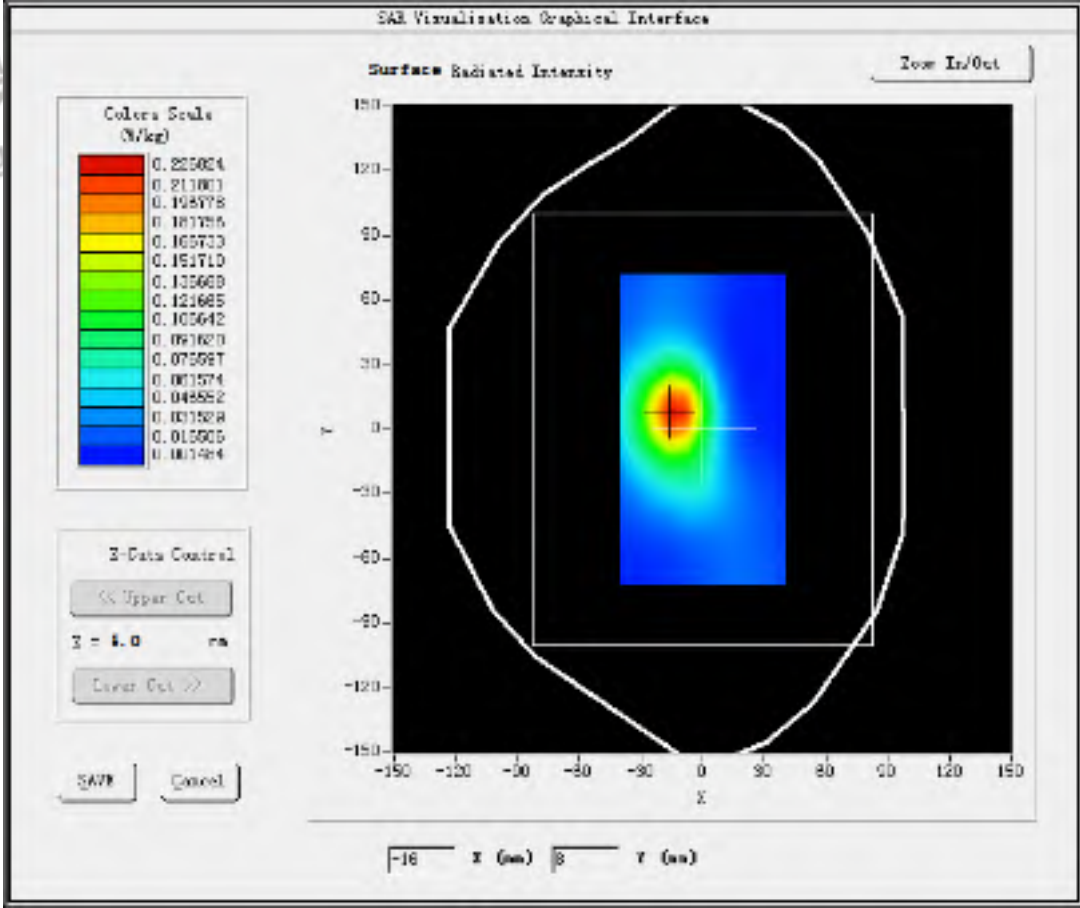
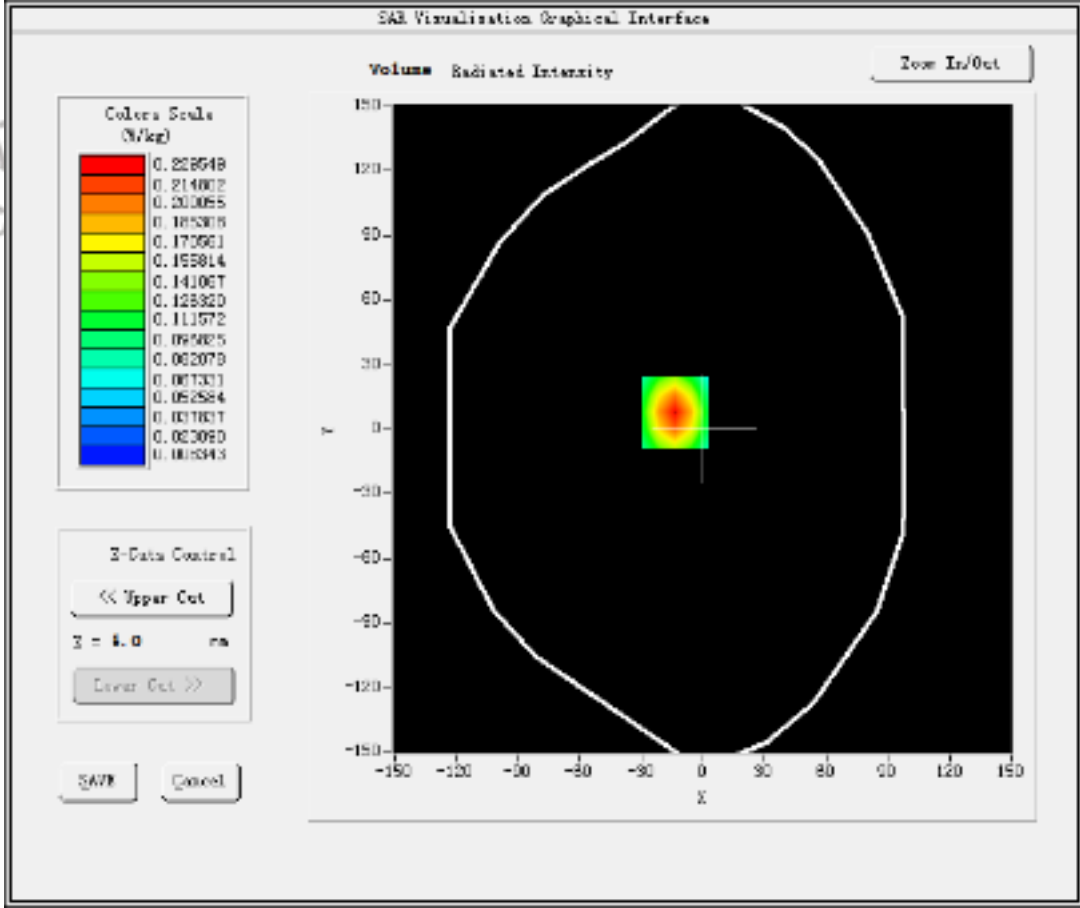
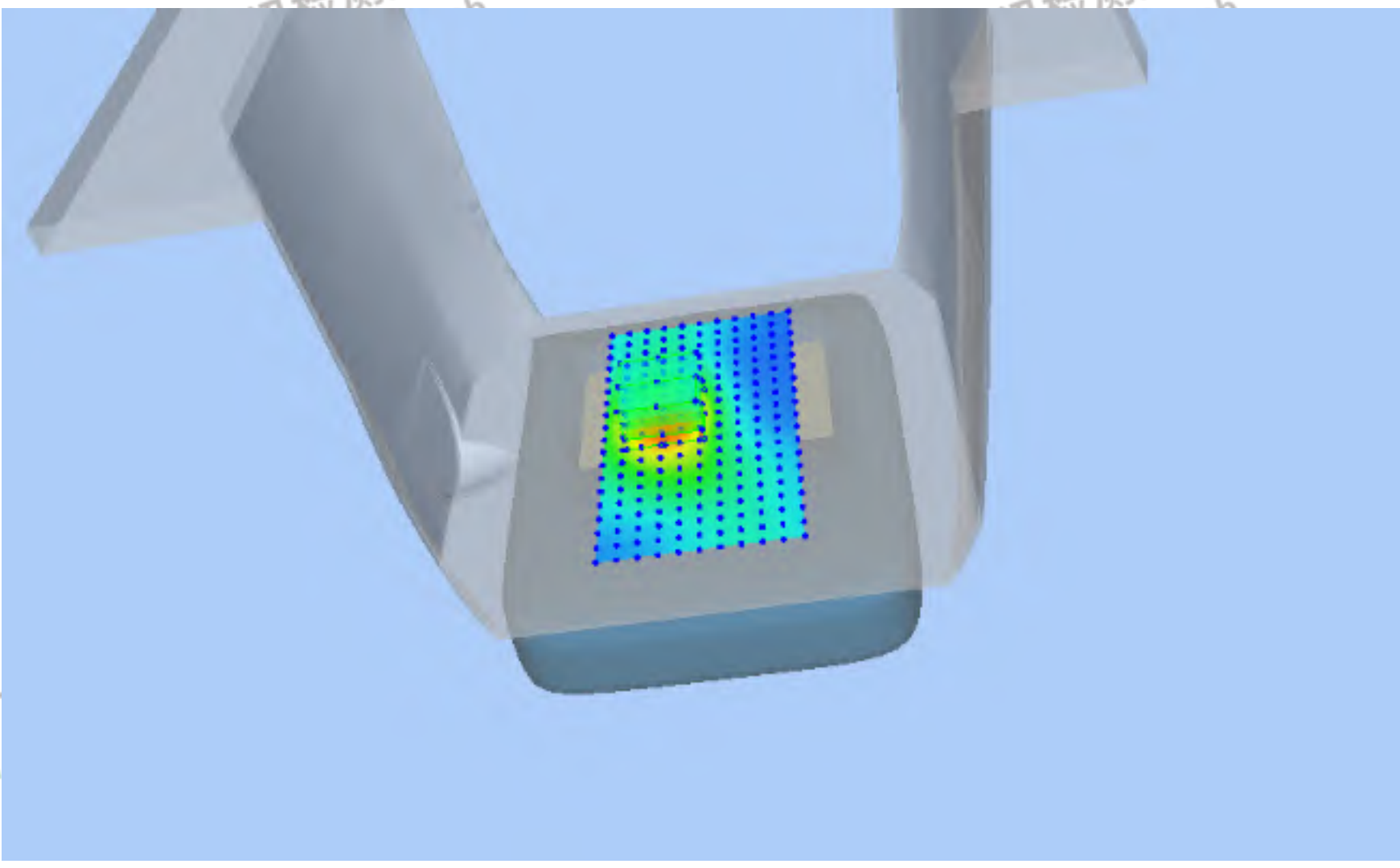
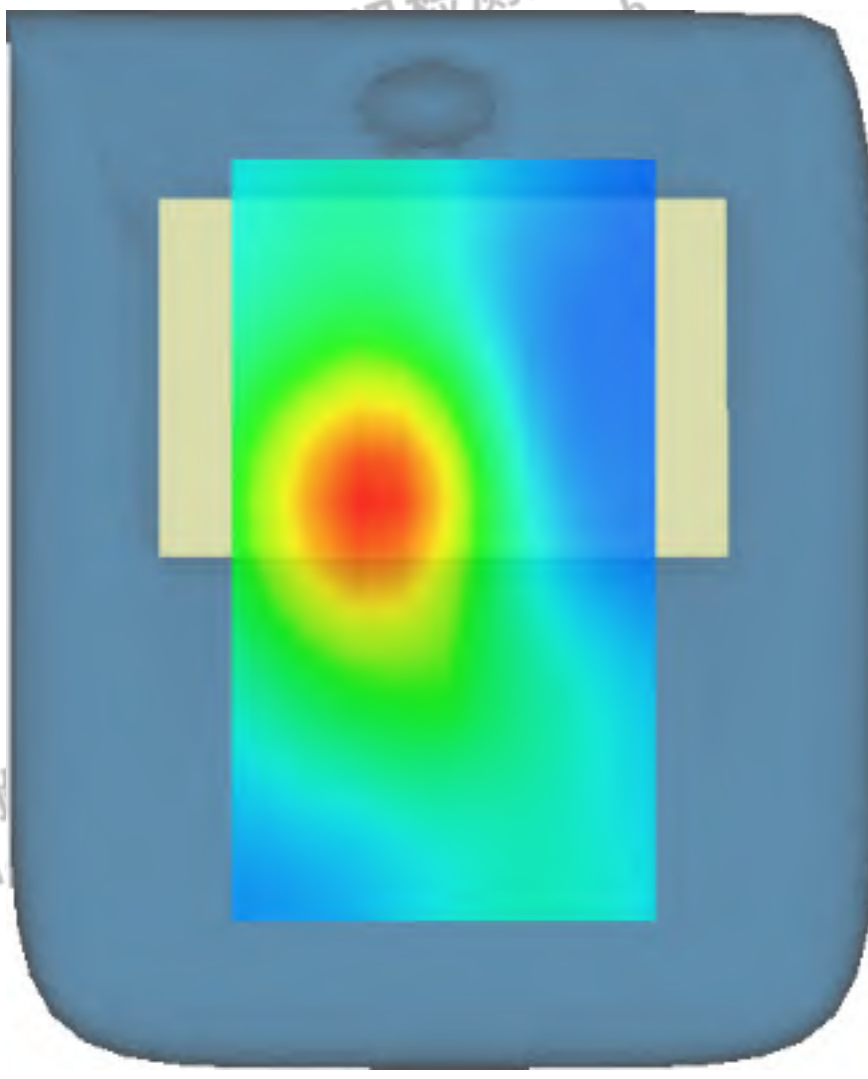
#10

Test Mode: 802.11b (WiFi2.4G), Low channel(Body Rear Side)

Product Description: Tablet PC

Model: VK-TM102-U

Test Date: July 04, 2023

Medium(liquid type)	MSL_2450
Frequency (MHz)	2412.0000
Relative permittivity (real part)	54.46
Conductivity (S/m)	1.93
E-Field Probe	SN25/22 EPGO376
Crest Factor	1.0
Conversion Factor	2.70
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7, dx=8mm dy=8mm dz=5mm
Variation (%)	-0.520000
SAR 10g (W/Kg)	0.124853
SAR 1g (W/Kg)	0.257512
SURFACE SAR	VOLUME SAR
	
	

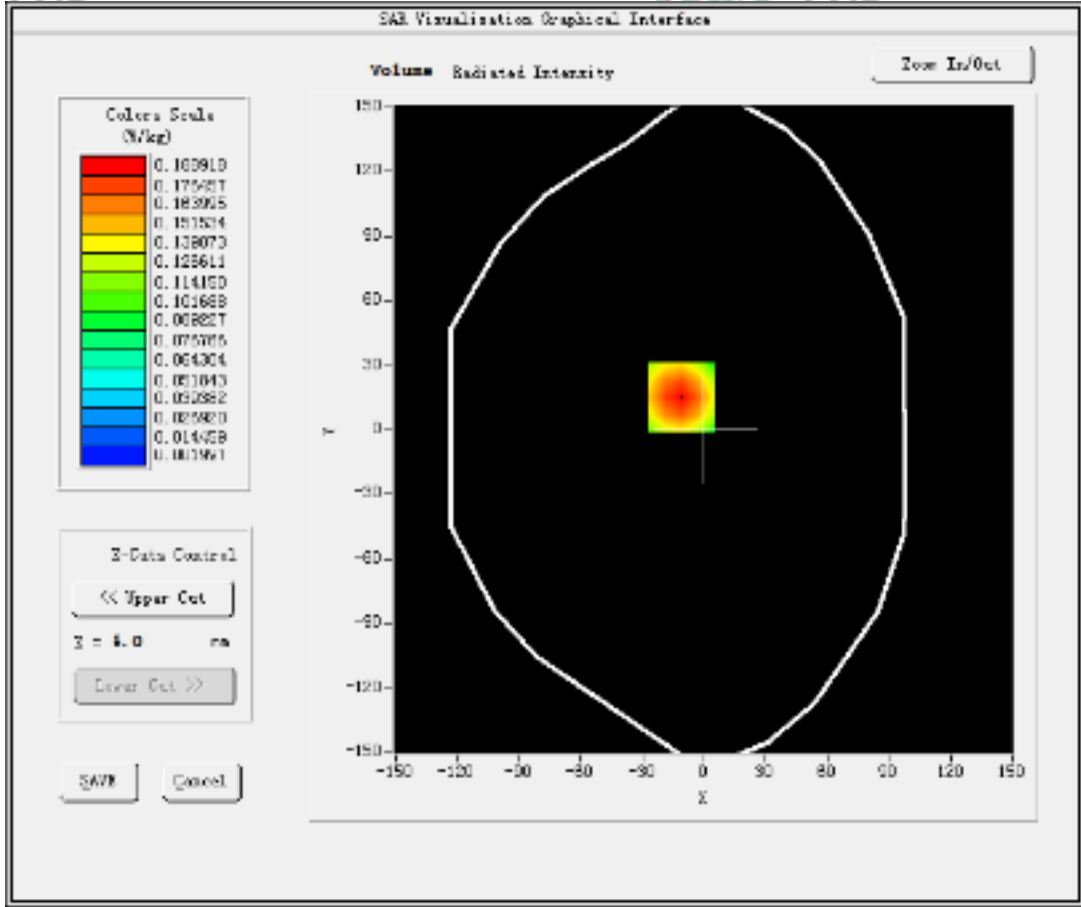
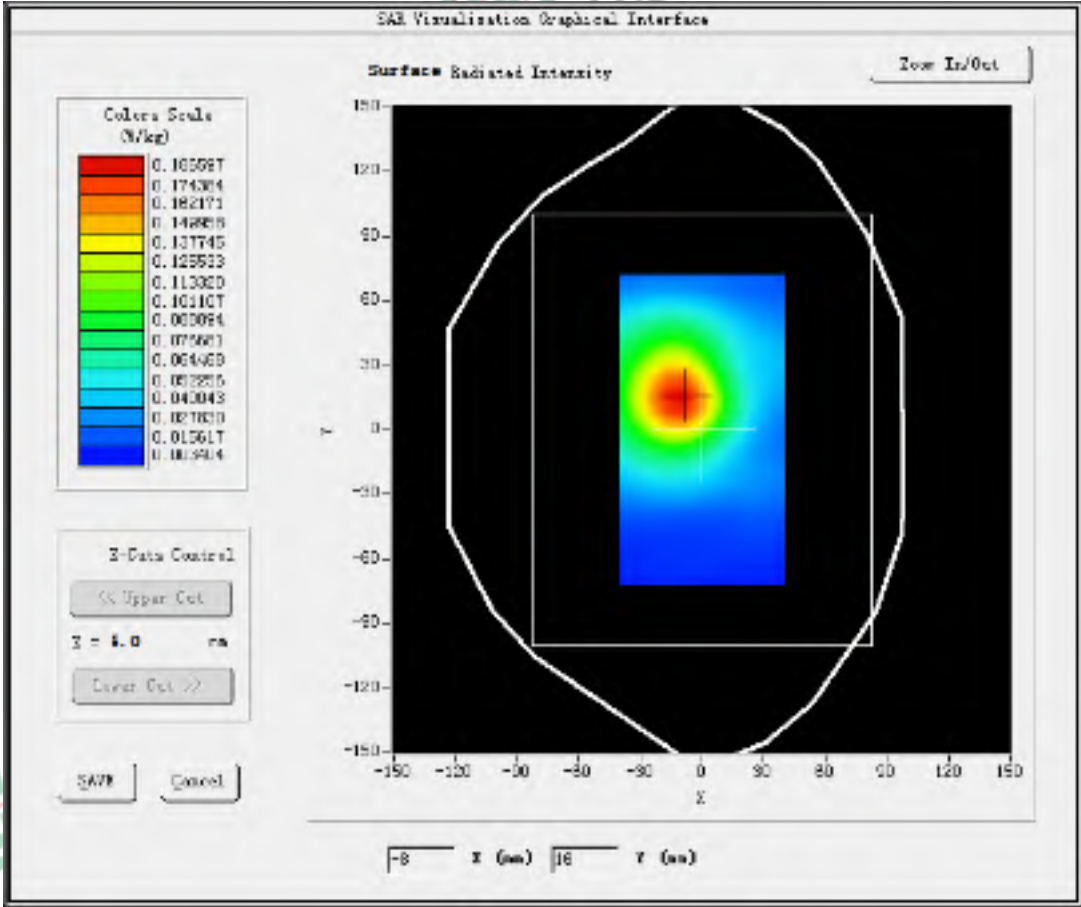


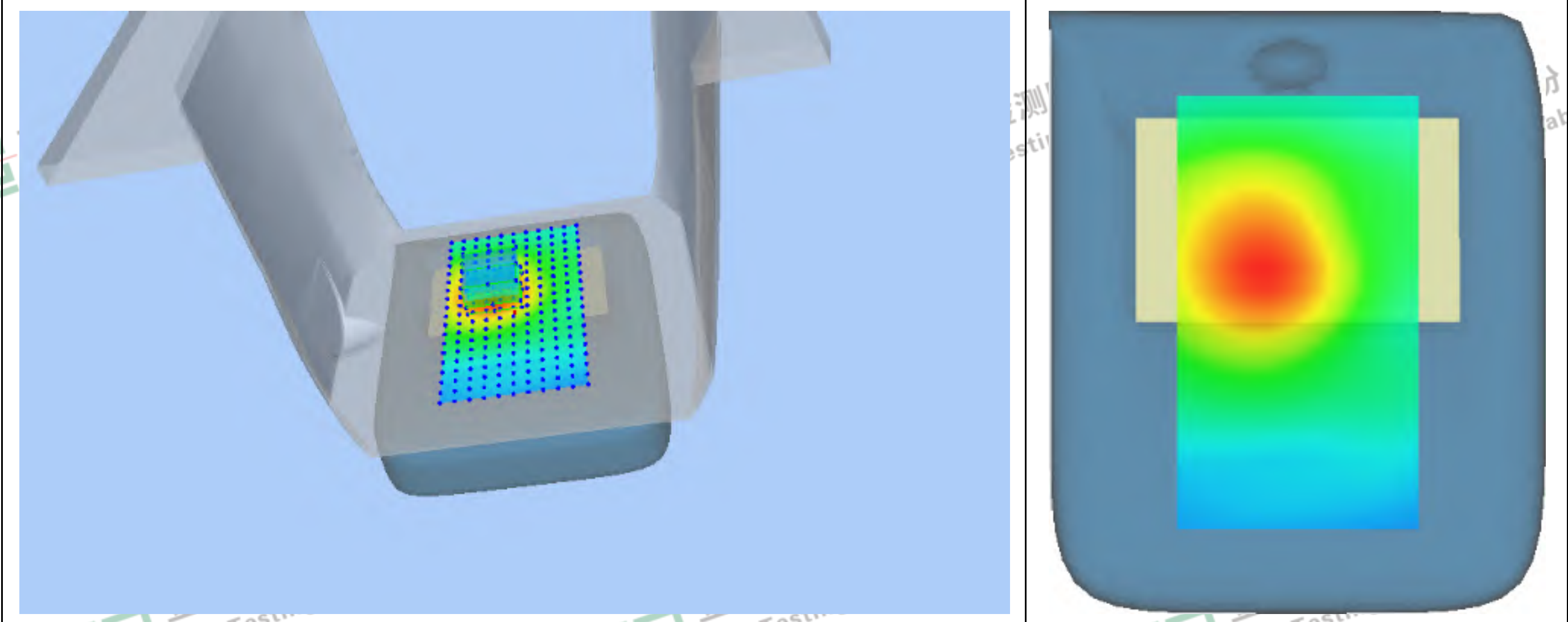


#11

Test Mode: 802.11a (WiFi5.2G),High channel(Body Rear Side)
Product Description: Tablet PC
Model: VK-TM1 02-U
Test Date: July 07, 2023

Medium(liquidtype)	MSL_5000
Frequency (MHz)	5240.0000
Relative permittivity (real part)	49.42
Conductivity (S/m)	5.26
E-FieldProbe	SN 25/22 EPGO376
Crest Factor	1.0
Conversion Factor	1.81
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	0.020000
SAR 10g (W/Kg)	0.095318
SAR 1g (W/Kg)	0.222084
SURFACE SAR	VOLUME SAR



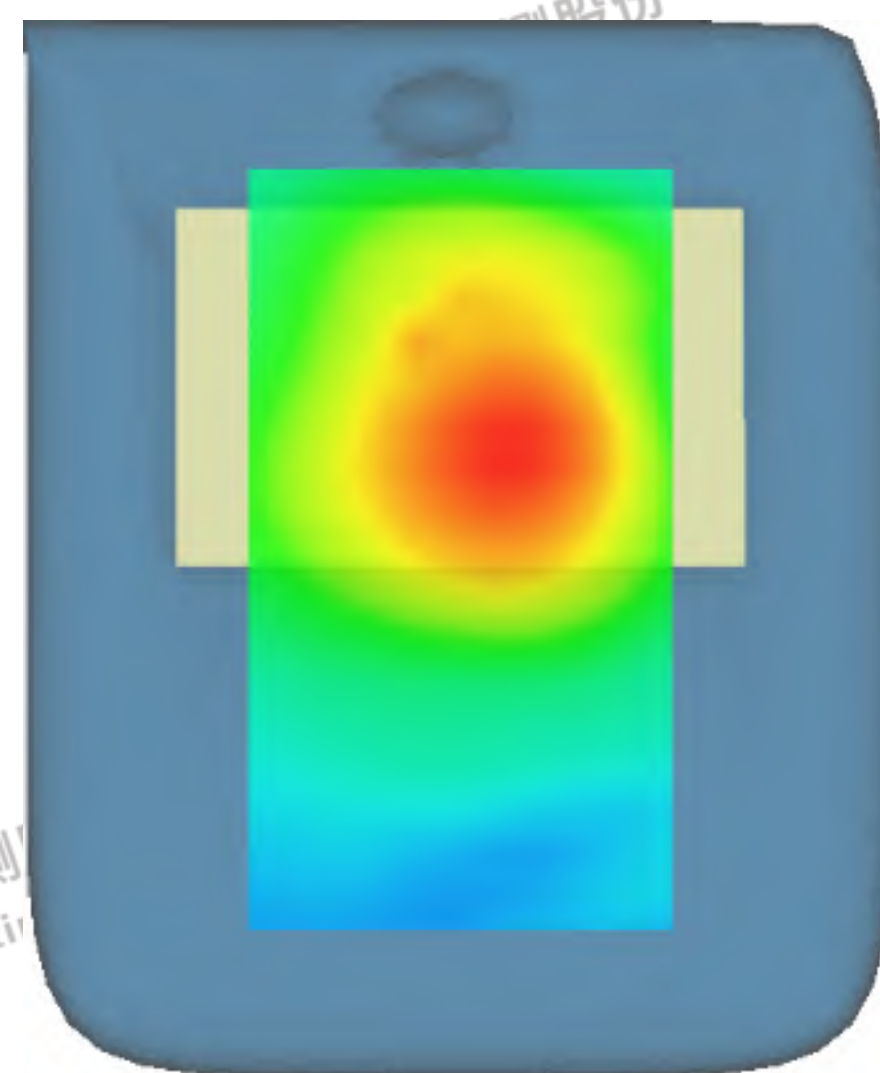
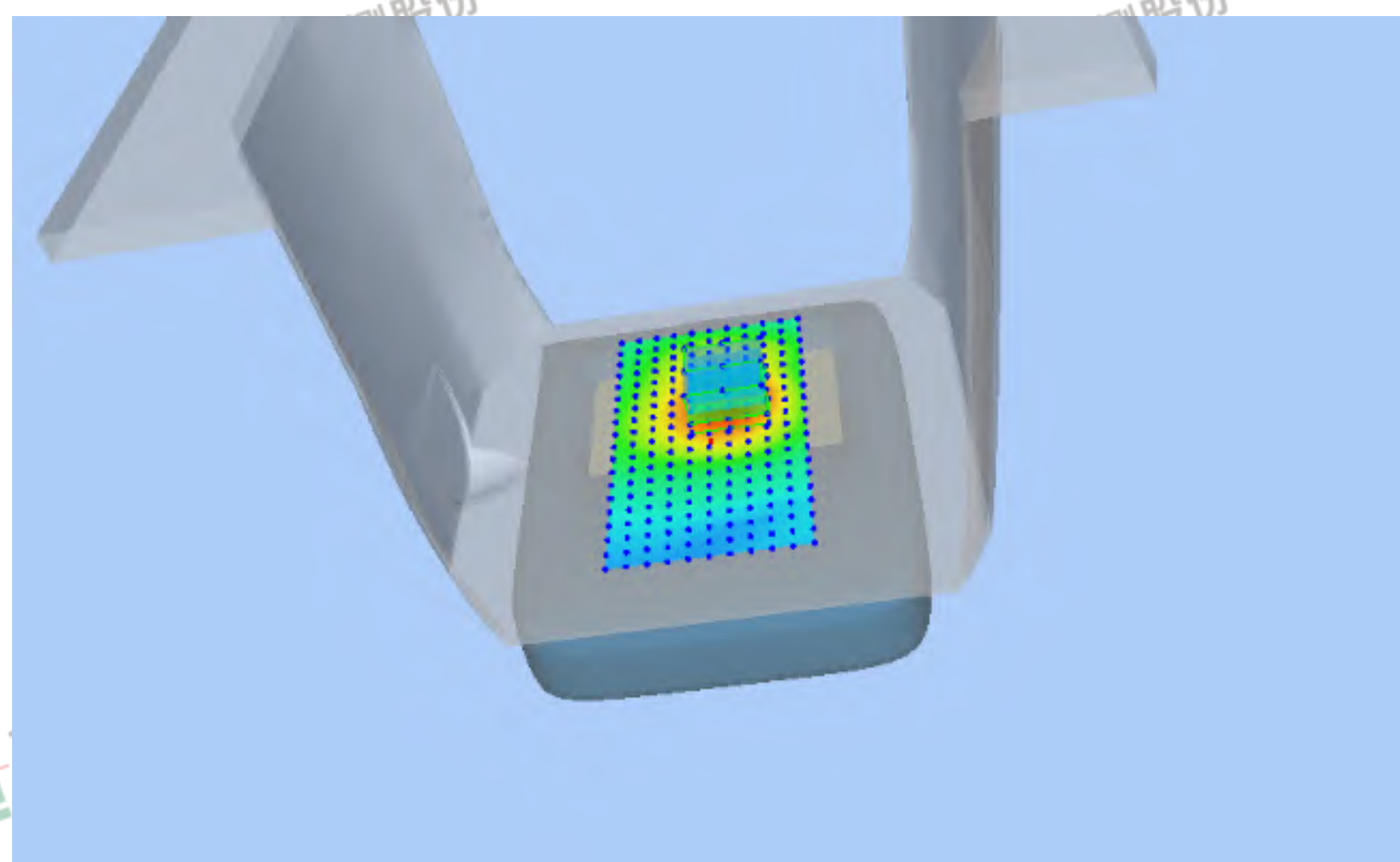
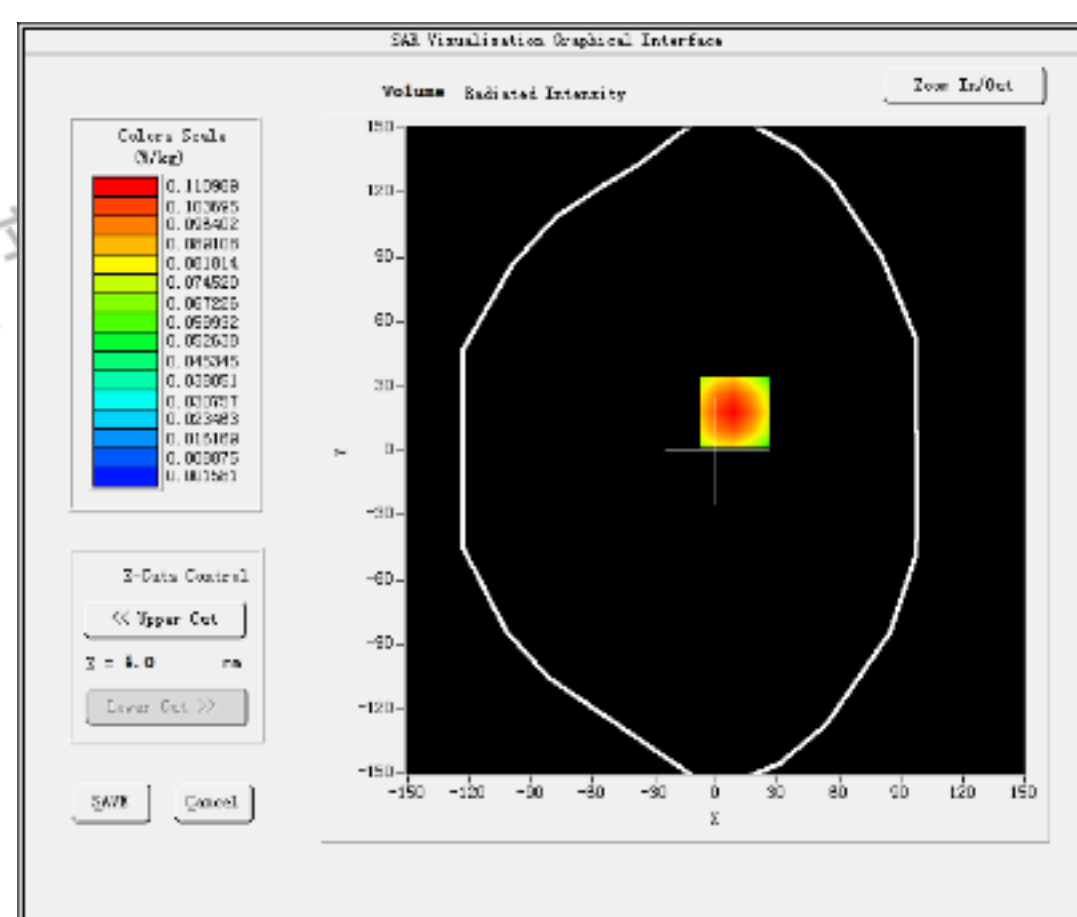
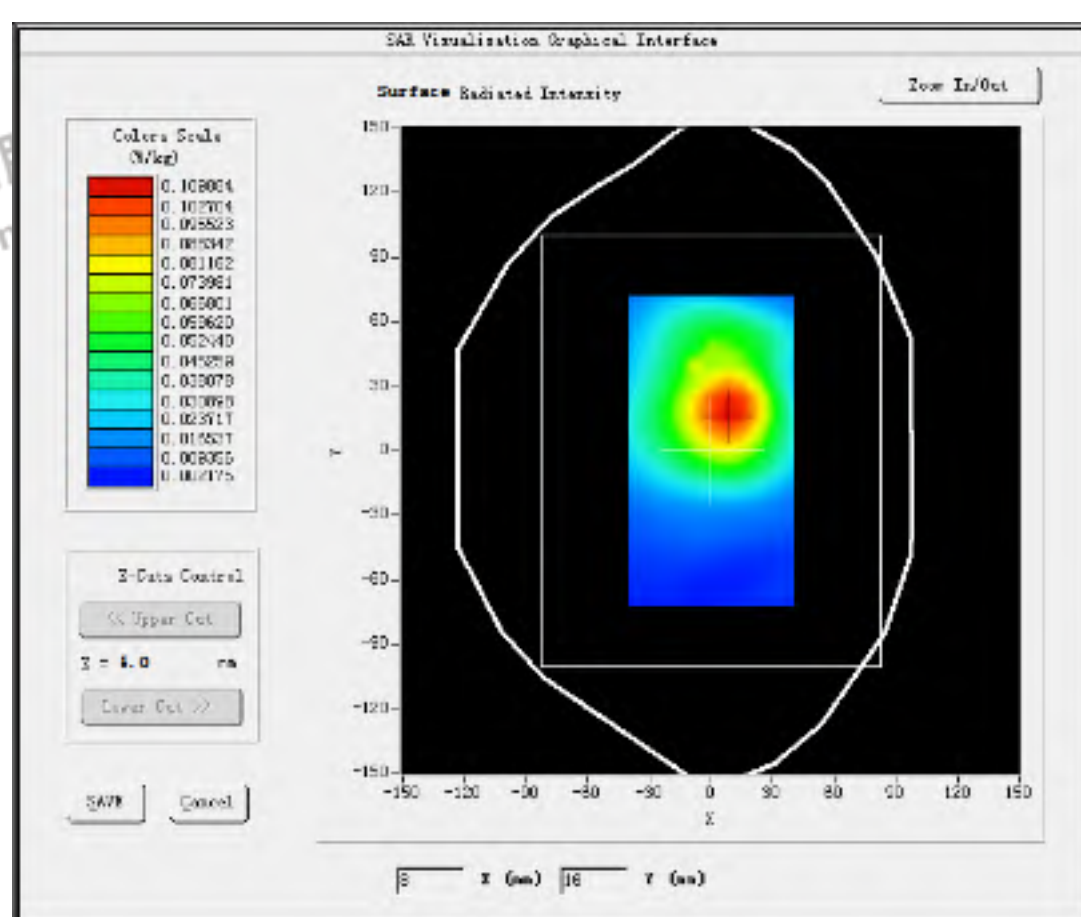


#12

Test Mode: 802.11a (WiFi5.8G),High channel(Body Rear Side)
Product Description: Tablet PC
Model: VK-TM1 02-U
Test Date: July 12, 2023

Medium(liquidtype)	MSL_5000
Frequency (MHz)	5825.0000
Relativepermittivity (real part)	47.96
Conductivity (S/m)	6.03
E-FieldProbe	SN25/22 EPGO376
CrestFactor	1.0
Conversion Factor	1.97
Sensor	4mm
AreaScan	dx=8mmdy=8mm
ZoomScan	5x5x7,dx=8mmdy=8mmdz=5mm
Variation (%)	0.320000
SAR 10g(W/Kg)	0.056221
SAR 1g(W/Kg)	0.131758
SURFACE SAR	VOLUME SAR







5. CALIBRATION CERTIFICATES

5.1 Probe-EPGO376 Calibration Certificate



COMOSAR E-Field Probe Calibration Report

Ref : ACR.180.4.42.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: 06/22/2023



Accreditations #2-6792

Scope available on www.cofrac.fr

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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).





COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.180.4.42.BES.A

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	<i>Name</i>	<i>Function</i>	<i>Date</i>	<i>Signature</i>
<i>Prepared by :</i>	Jérôme Le Gall	Measurement Responsible	6/23/2023	
<i>Checked & approved by:</i>	Jérôme Luc	Technical Manager	6/23/2023	
<i>Authorized by:</i>	Yann Toutain	Laboratory Director	6/23/2023	

2023.06.23

13:37:50 +02'03'

	<i>Customer Name</i>
<i>Distribution :</i>	Shenzhen LCS Compliance Testing Laboratory Ltd.

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<i>Issue</i>	<i>Name</i>	<i>Date</i>	<i>Modifications</i>
A	Jérôme Le Gall	6/23/2023	Initial release

Page: 2/11

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Scan code to check authenticity



COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.180.4 42.BES.A

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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:

$$SAR_{uncertainty} [\%] = \Delta SAR_{be} \frac{(d_{be} + d_{step})^2}{2d_{step}} \frac{(e^{-d_{be}/\delta} - e^{-(d_{be} + d_{step})/\delta})}{\delta/2} \quad \text{for } (d_{be} + d_{step}) < 10 \text{ mm}$$

where

$SAR_{uncertainty}$	is the uncertainty in percent of the probe boundary effect
d_{be}	is the distance between the surface and the closest <i>zoom-scan</i> 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;
ΔSAR_{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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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	ei	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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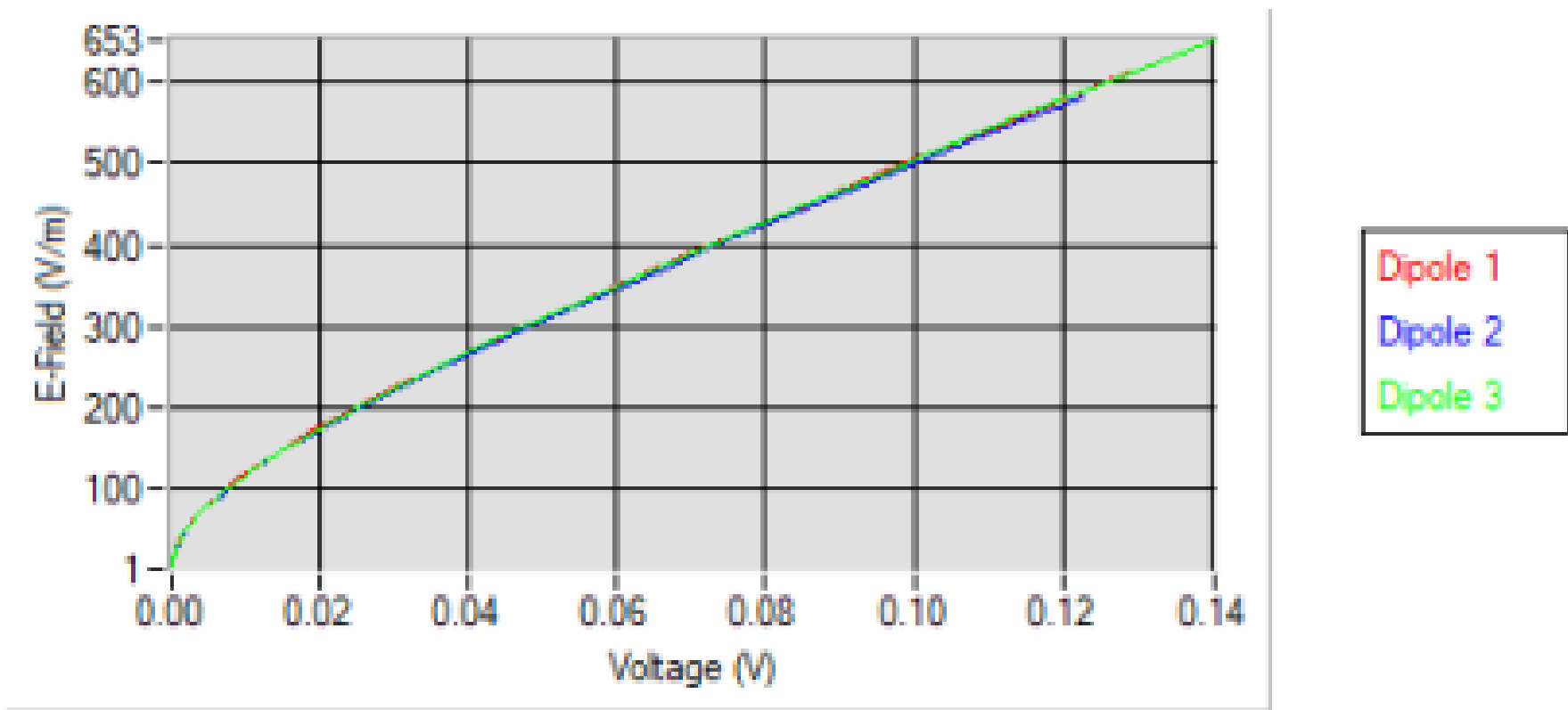


COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.180.4.42.BES.A

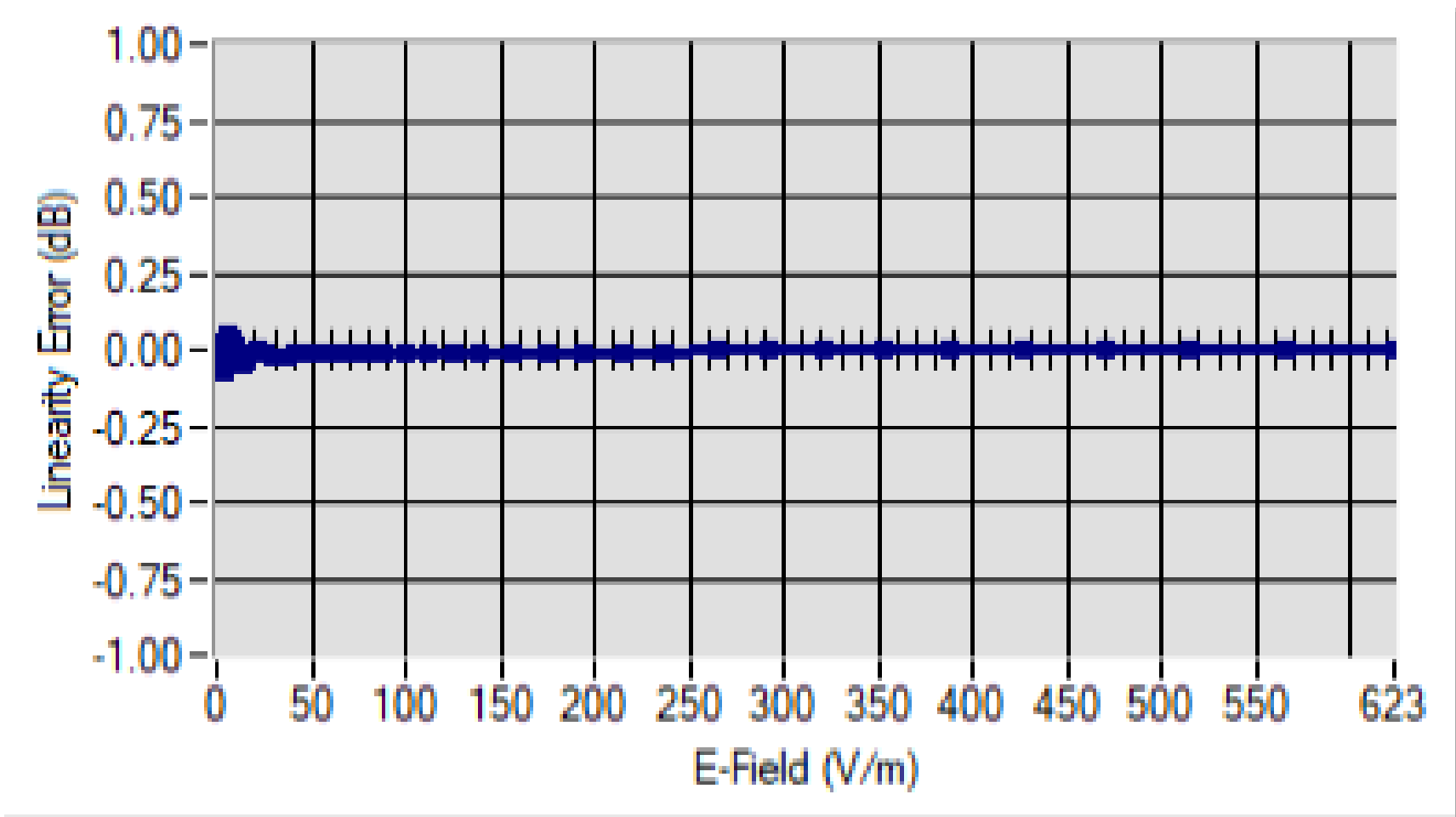
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Calibration curves



5.2 LINEARITY

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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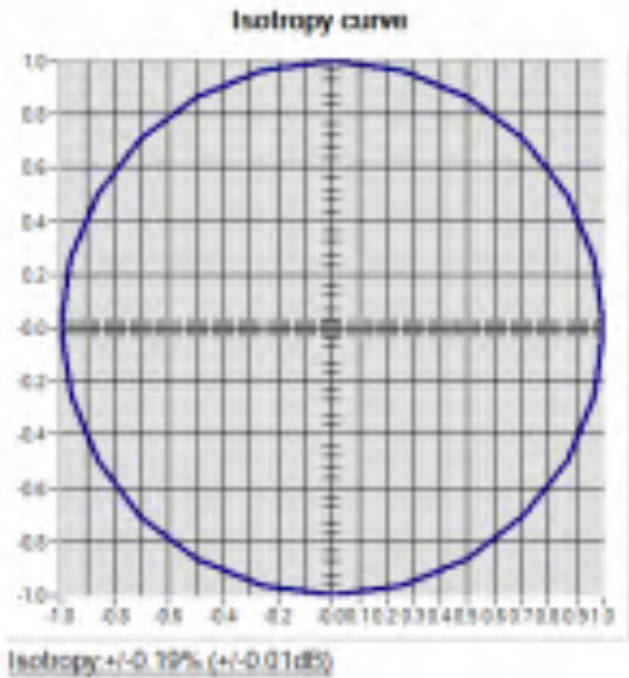
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5.4 ISOTROPY

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	10/2022	10/2025
Network Analyzer – Calibration kit	HP 85033D	3423A08186	06/2021	06/2027
Multimeter	Keithley 2000	1160271	02/2023	02/2026
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	11/2022	11/2025
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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5.2SID750Dipole Calibration Certificate



SAR Reference Dipole Calibration Report

Ref : ACR.287.3.14.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: 750 MHZ

SERIAL NO.: SN 07/14 DIP 0G750-302

Calibrated at SATIMO US

2105 Barrett Park Dr. - Kennesaw, GA 30144



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.



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



SAR REFERENCE DIPOLE CALIBRATION REPORT

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

	Customer Name
Distribution :	Shenzhen LCS Compliance Testing Laboratory Ltd.

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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 750 MHz REFERENCE DIPOLE
Manufacturer	Satimo
Model	SID750
Serial Number	SN 07/14 DIP 0G750-302
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 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, 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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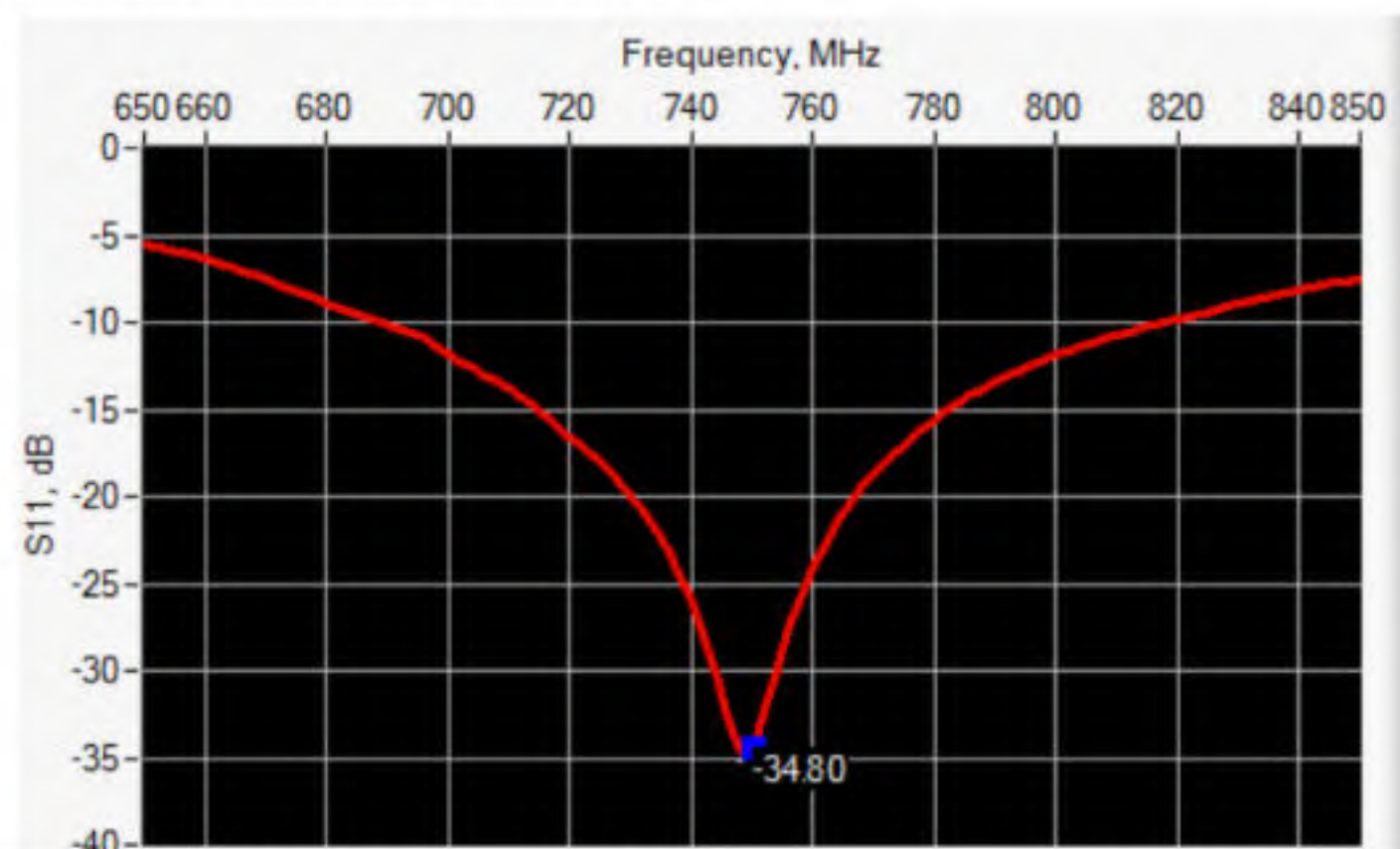
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6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
750	-34.80	-20	50.7 Ω + 1.6 j Ω

6.2 MECHANICAL DIMENSIONS

Frequency MHz	L mm		h mm		d mm	
	required	measured	required	measured	required	measured
300	420.0 $\pm$ 1 %.		250.0 $\pm$ 1 %.		6.35 $\pm$ 1 %.	
450	290.0 $\pm$ 1 %.		166.7 $\pm$ 1 %.		6.35 $\pm$ 1 %.	
750	176.0 $\pm$ 1 %.	PASS	100.0 $\pm$ 1 %.	PASS	6.35 $\pm$ 1 %.	PASS
835	161.0 $\pm$ 1 %.		89.8 $\pm$ 1 %.		3.6 $\pm$ 1 %.	
900	149.0 $\pm$ 1 %.		83.3 $\pm$ 1 %.		3.6 $\pm$ 1 %.	
1450	89.1 $\pm$ 1 %.		51.7 $\pm$ 1 %.		3.6 $\pm$ 1 %.	
1500	80.5 $\pm$ 1 %.		50.0 $\pm$ 1 %.		3.6 $\pm$ 1 %.	
1640	79.0 $\pm$ 1 %.		45.7 $\pm$ 1 %.		3.6 $\pm$ 1 %.	
1750	75.2 $\pm$ 1 %.		42.9 $\pm$ 1 %.		3.6 $\pm$ 1 %.	
1800	72.0 $\pm$ 1 %.		41.7 $\pm$ 1 %.		3.6 $\pm$ 1 %.	
1900	68.0 $\pm$ 1 %.		39.5 $\pm$ 1 %.		3.6 $\pm$ 1 %.	
1950	66.3 $\pm$ 1 %.		38.5 $\pm$ 1 %.		3.6 $\pm$ 1 %.	
2000	64.5 $\pm$ 1 %.		37.5 $\pm$ 1 %.		3.6 $\pm$ 1 %.	
2100	61.0 $\pm$ 1 %.		35.7 $\pm$ 1 %.		3.6 $\pm$ 1 %.	
2300	55.5 $\pm$ 1 %.		32.6 $\pm$ 1 %.		3.6 $\pm$ 1 %.	
2450	51.5 $\pm$ 1 %.		30.4 $\pm$ 1 %.		3.6 $\pm$ 1 %.	
2600	48.5 $\pm$ 1 %.		28.8 $\pm$ 1 %.		3.6 $\pm$ 1 %.	
3000	41.5 $\pm$ 1 %.		25.0 $\pm$ 1 %.		3.6 $\pm$ 1 %.	
3500	37.0 $\pm$ 1 %.		26.4 $\pm$ 1 %.		3.6 $\pm$ 1 %.	
3700	34.7 $\pm$ 1 %.		26.4 $\pm$ 1 %.		3.6 $\pm$ 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 $\pm$ 5 %		0.87 $\pm$ 5 %	
450	43.5 $\pm$ 5 %		0.87 $\pm$ 5 %	
750	41.9 $\pm$ 5 %	PASS	0.89 $\pm$ 5 %	PASS
835	41.5 $\pm$ 5 %		0.90 $\pm$ 5 %	
900	41.5 $\pm$ 5 %		0.97 $\pm$ 5 %	
1450	40.5 $\pm$ 5 %		1.20 $\pm$ 5 %	
1500	40.4 $\pm$ 5 %		1.23 $\pm$ 5 %	
1640	40.2 $\pm$ 5 %		1.31 $\pm$ 5 %	
1750	40.1 $\pm$ 5 %		1.37 $\pm$ 5 %	
1800	40.0 $\pm$ 5 %		1.40 $\pm$ 5 %	
1900	40.0 $\pm$ 5 %		1.40 $\pm$ 5 %	
1950	40.0 $\pm$ 5 %		1.40 $\pm$ 5 %	
2000	40.0 $\pm$ 5 %		1.40 $\pm$ 5 %	
2100	39.8 $\pm$ 5 %		1.49 $\pm$ 5 %	
2300	39.5 $\pm$ 5 %		1.67 $\pm$ 5 %	
2450	39.2 $\pm$ 5 %		1.80 $\pm$ 5 %	
2600	39.0 $\pm$ 5 %		1.96 $\pm$ 5 %	
3000	38.5 $\pm$ 5 %		2.40 $\pm$ 5 %	
3500	37.9 $\pm$ 5 %		2.91 $\pm$ 5 %	

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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: ϵ_r' : 42.1 sigma : 0.89
Distance between dipole center and liquid	15.0 mm
Area scan resolution	dx=8mm/dy=8mm

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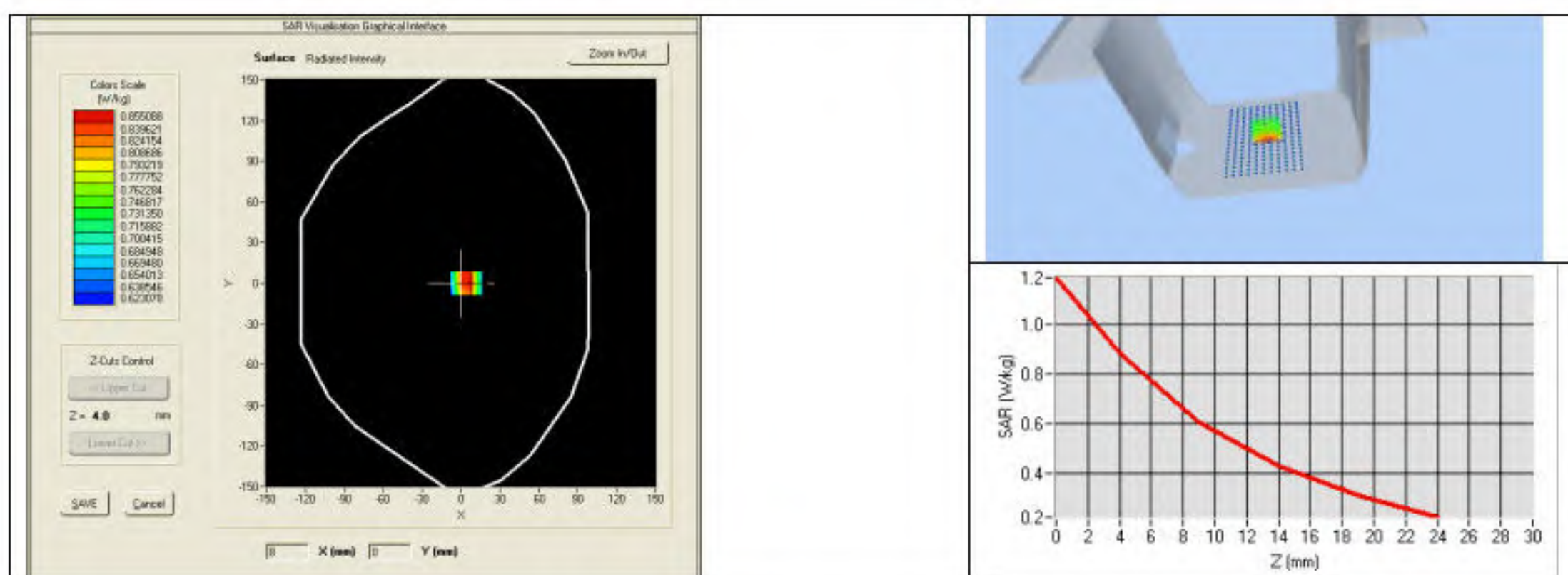
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Zoon Scan Resolution	dx=8mm/dy=8m/dz=5mm
Frequency	750 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

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	8.38 (0.84)	5.55	5.53 (0.55)
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	
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 $\pm$ 5 %		0.80 $\pm$ 5 %	
300	58.2 $\pm$ 5 %		0.92 $\pm$ 5 %	
450	56.7 $\pm$ 5 %		0.94 $\pm$ 5 %	
750	55.5 $\pm$ 5 %	PASS	0.96 $\pm$ 5 %	PASS
835	55.2 $\pm$ 5 %		0.97 $\pm$ 5 %	
900	55.0 $\pm$ 5 %		1.05 $\pm$ 5 %	
915	55.0 $\pm$ 5 %		1.06 $\pm$ 5 %	
1450	54.0 $\pm$ 5 %		1.30 $\pm$ 5 %	
1610	53.8 $\pm$ 5 %		1.40 $\pm$ 5 %	
1800	53.3 $\pm$ 5 %		1.52 $\pm$ 5 %	
1900	53.3 $\pm$ 5 %		1.52 $\pm$ 5 %	
2000	53.3 $\pm$ 5 %		1.52 $\pm$ 5 %	
2100	53.2 $\pm$ 5 %		1.62 $\pm$ 5 %	
2450	52.7 $\pm$ 5 %		1.95 $\pm$ 5 %	
2600	52.5 $\pm$ 5 %		2.16 $\pm$ 5 %	
3000	52.0 $\pm$ 5 %		2.73 $\pm$ 5 %	
3500	51.3 $\pm$ 5 %		3.31 $\pm$ 5 %	
5200	49.0 $\pm$ 10 %		5.30 $\pm$ 10 %	
5300	48.9 $\pm$ 10 %		5.42 $\pm$ 10 %	
5400	48.7 $\pm$ 10 %		5.53 $\pm$ 10 %	
5500	48.6 $\pm$ 10 %		5.65 $\pm$ 10 %	
5600	48.5 $\pm$ 10 %		5.77 $\pm$ 10 %	
5800	48.2 $\pm$ 10 %		6.00 $\pm$ 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: ϵ_{ps}' : 56.6 sigma : 0.99
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	750 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

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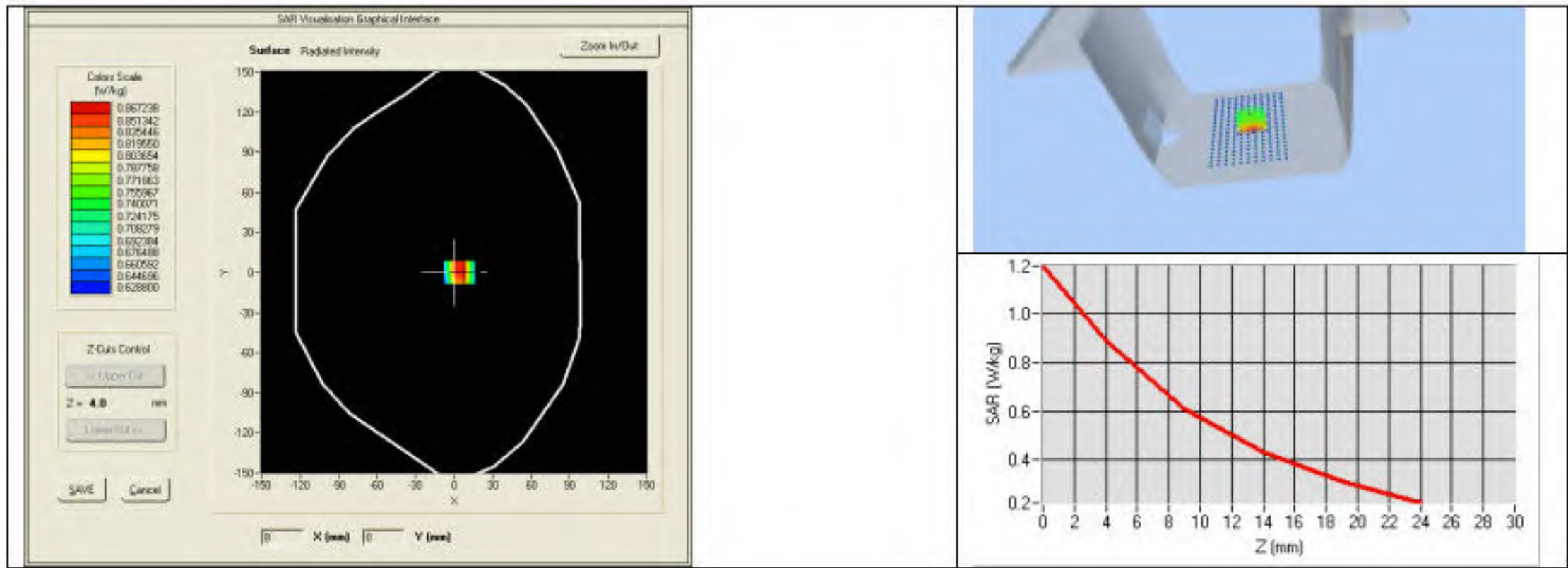




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Frequency MHz	1 g SAR (W/kg/W)	10 g SAR (W/kg/W)
	measured	measured
750	8.77 (0.88)	5.78 (0.58)



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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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5.3SID835Dipole Calibration Certificate



SAR Reference Dipole Calibration Report

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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



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.





SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.287.4.14.SATU.A

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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 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, 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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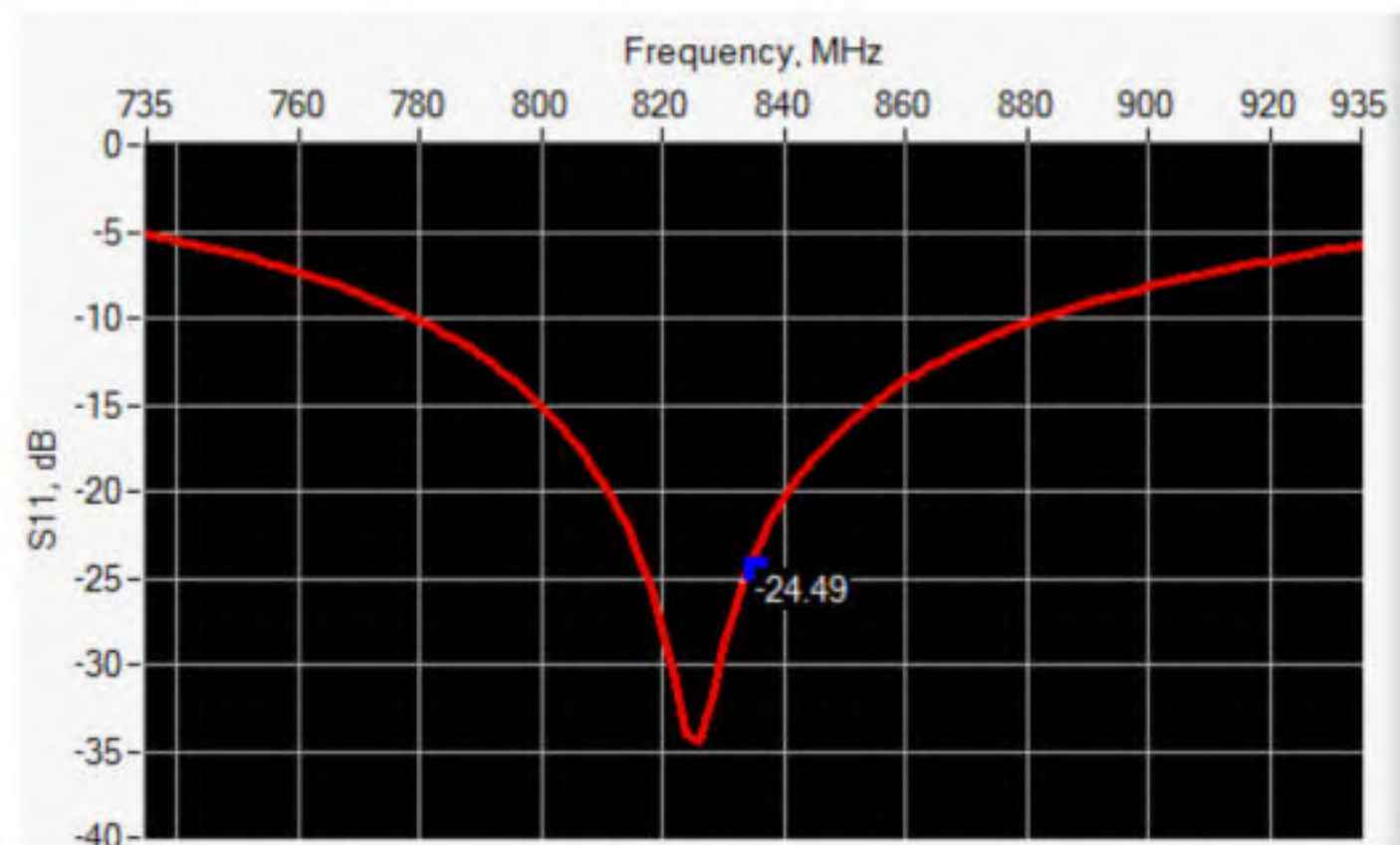
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6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE



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

6.2 MECHANICAL DIMENSIONS

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

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