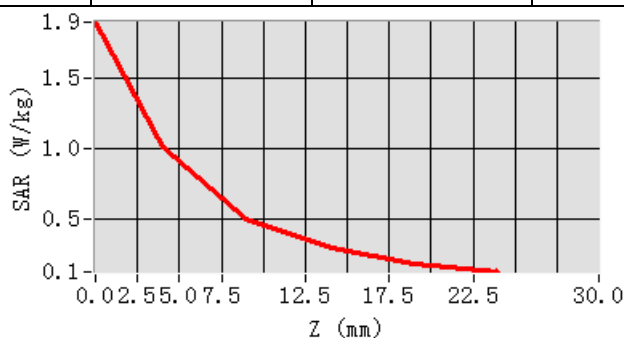
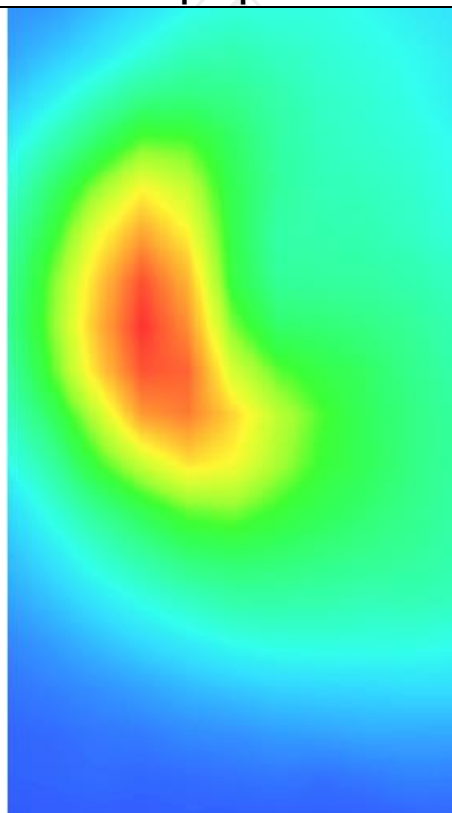


Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	1.8998	1.0073	0.4897	0.2862	0.1796



Hot spot position



GSM1900

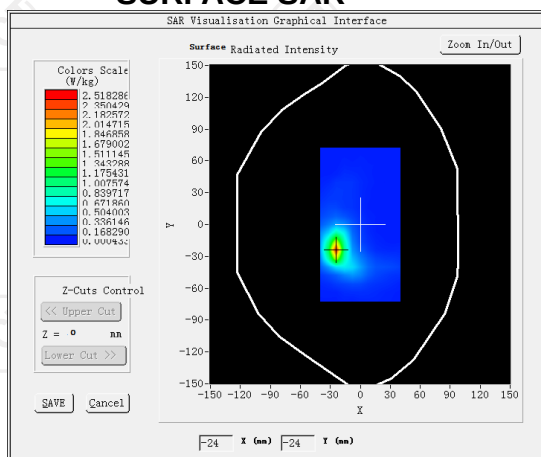
MEASUREMENT 1

Middle Band SAR (Channel 661):

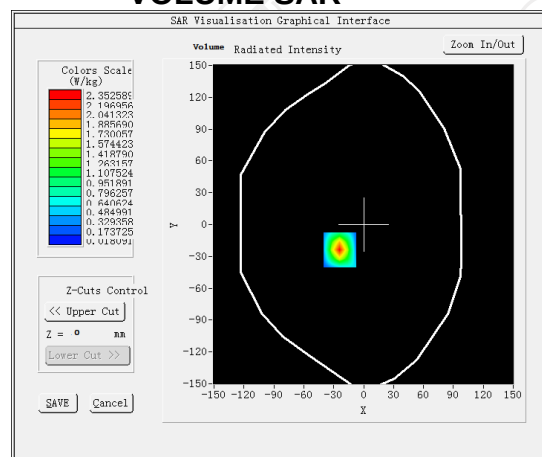
Date: 08/21/2023

Frequency (MHz)	1880.000000
Relative permittivity (real part)	40.000000
Relative permittivity (imaginary part)	13.408000
Conductivity (S/m)	1.400391
Variation (%)	-0.830000
Crest Factor	1.0
Probe Conversion factor	2.23
E-Field Probe:	SSE2 (SN 25/22 EPG0375)
Area Scan	dx=8mm dy=8mm, h= 5.00 mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete/ndx=8mm dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Body back(0mm)
Band	GSM1900(GPRS 2slot)

SURFACE SAR



VOLUME SAR



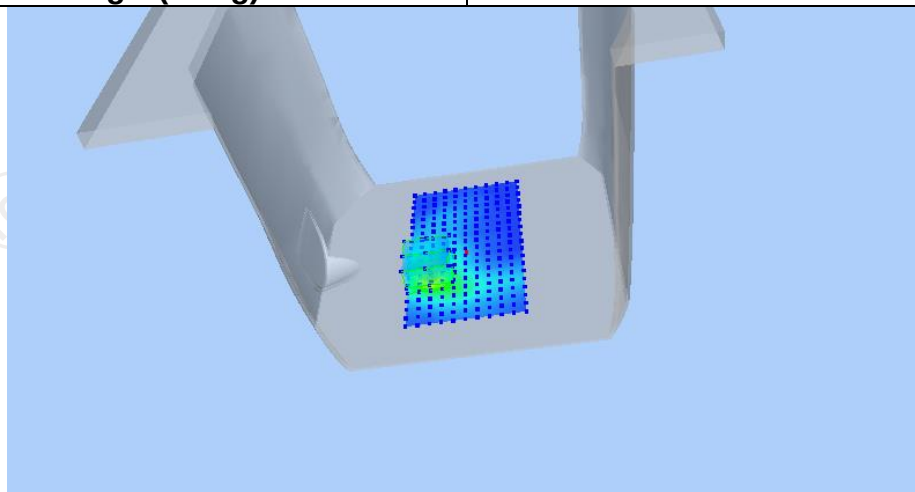
Maximum location: X=-24.00, Y=-24.00 SAR Peak:1.79 W/kg

SAR 10g (W/Kg)

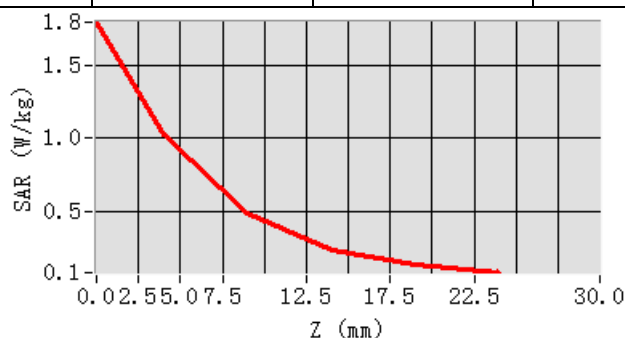
0.464003

SAR 1g (W/Kg)

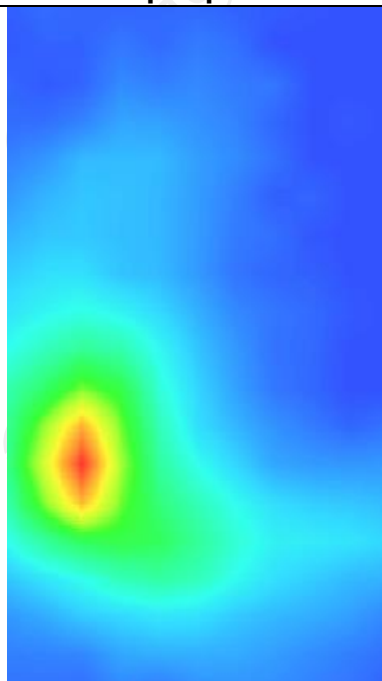
0.705943



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	1.7918	1.0248	0.4870	0.2387	0.1364



Hot spot position



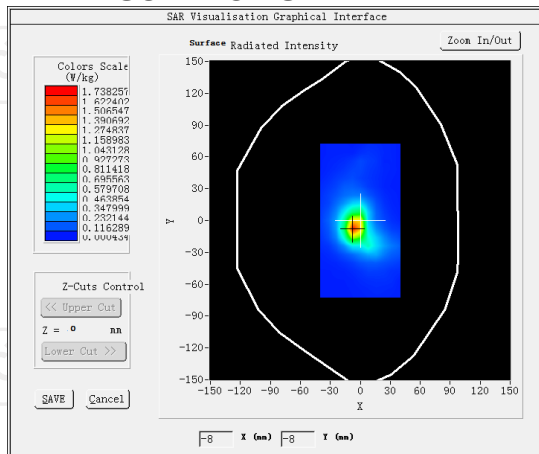
MEASUREMENT 2

Middle Band SAR (Channel 661):

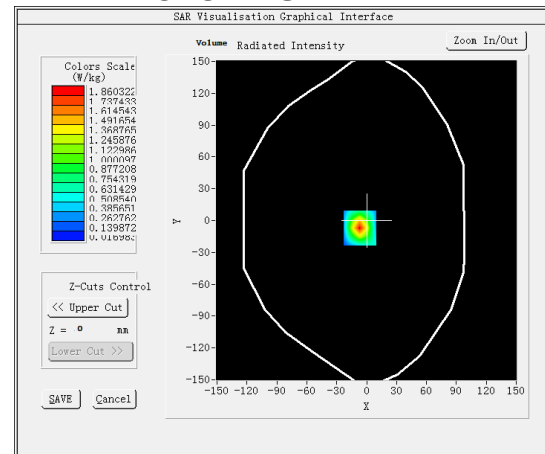
Date: 08/21/2023

Frequency (MHz)	1880.000000
Relative permittivity (real part)	40.000000
Relative permittivity (imaginary part)	13.408000
Conductivity (S/m)	1.400391
Variation (%)	-0.620000
Crest Factor	1.0
Probe Conversion factor	2.23
E-Field Probe:	SSE2 (SN 25/22 EPG0375)
Area Scan	<u>dx=8mm dy=8mm, h= 5.00 mm</u>
ZoomScan	<u>5x5x7,dx=8mm dy=8mm</u> <u>dz=5mm,Complete/ndx=8mm dy=8mm, h=</u> <u>5.00 mm</u>
Phantom	<u>Validation plane</u>
Device Position	<u>Body back(0mm)</u>
Band	<u>GSM1900(GPRS 2slot hotspot)</u>

SURFACE SAR

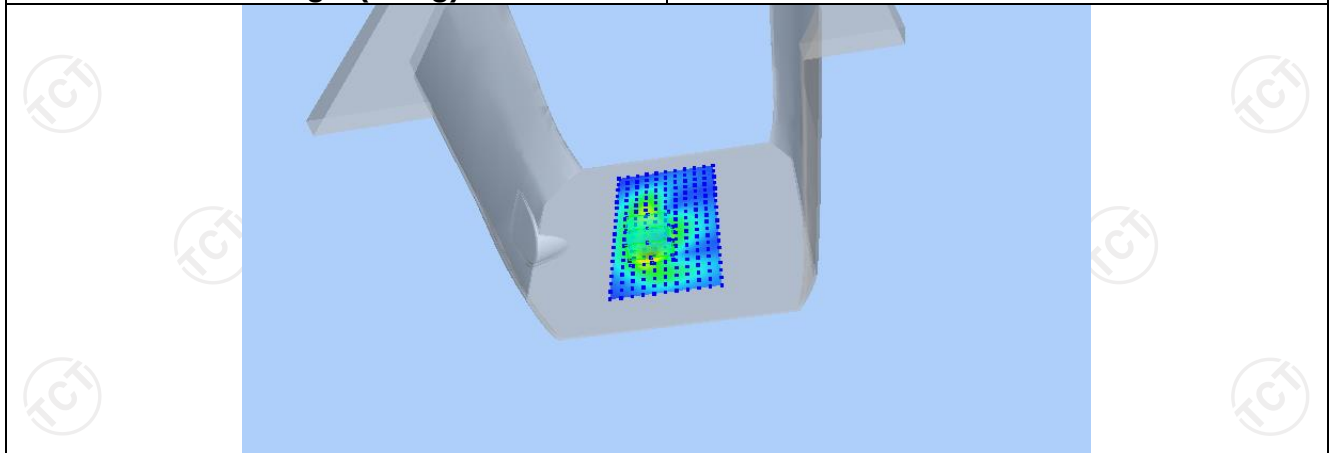


VOLUME SAR

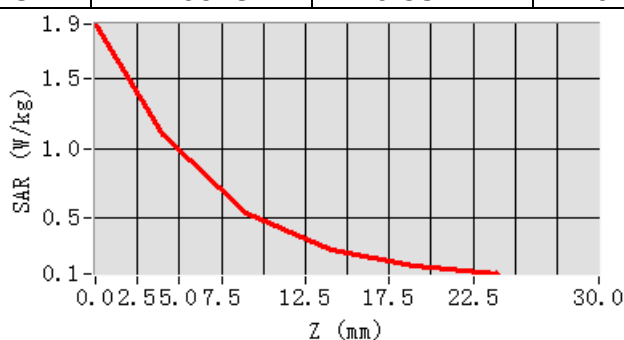


Maximum location: X=-7.00, Y=-7.00 SAR Peak: 1.89 W/kg

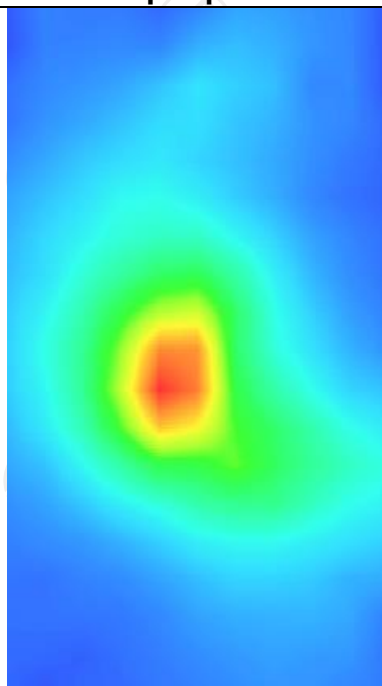
SAR 10g (W/Kg)	0.505055
SAR 1g (W/Kg)	0.727390



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	1.8913	1.0978	0.5344	0.2689	0.1563



Hot spot position



WCDMA Band II

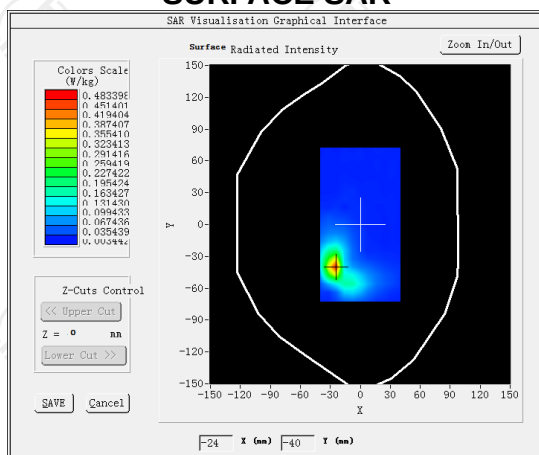
MEASUREMENT 1

Middle Band SAR (Channel 9400):

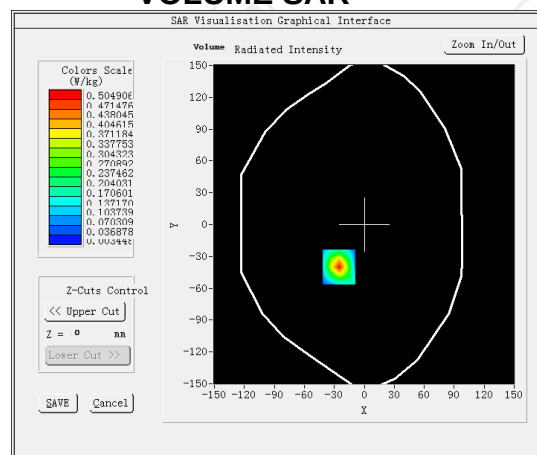
Date: 08/21/2023

Frequency (MHz)	1880.000000
Relative permittivity (real part)	40.000000
Relative permittivity (imaginary part)	13.408000
Conductivity (S/m)	1.400391
Variation (%)	-4.920000
Crest Factor	1.0
Probe Conversion factor	2.23
E-Field Probe:	SSE2 (SN 25/22 EPGO375)
Area Scan	<u>dx=8mm dy=8mm, h= 5.00 mm</u>
ZoomScan	<u>5x5x7, dx=8mm dy=8mm</u> <u>dz=5mm, Complete/ndx=8mm dy=8mm, h=</u> <u>5.00 mm</u>
Phantom	<u>Validation plane</u>
Device Position	<u>Body back(0mm)</u>
Band	<u>BAND2 WCDMA1900</u>

SURFACE SAR

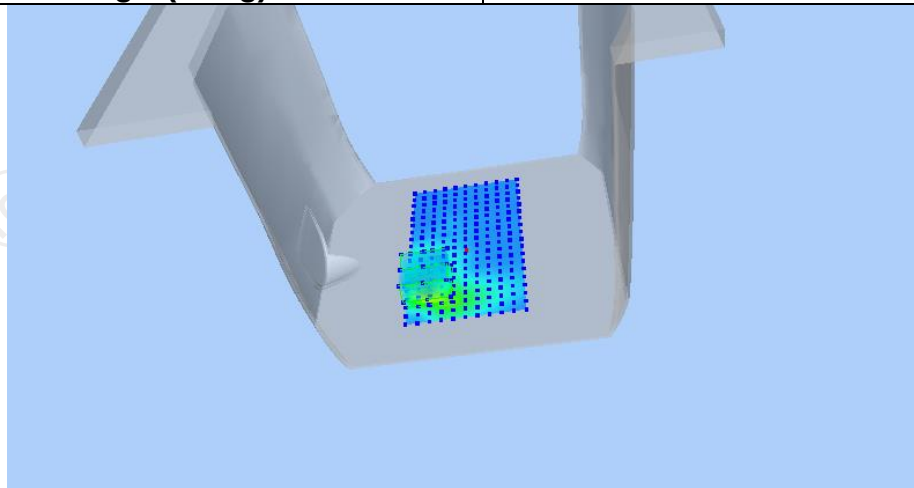


VOLUME SAR

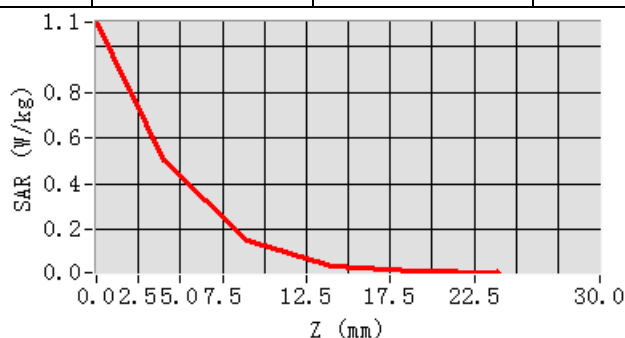


Maximum location: X=-25.00, Y=-40.00 SAR Peak: 1.10 W/kg

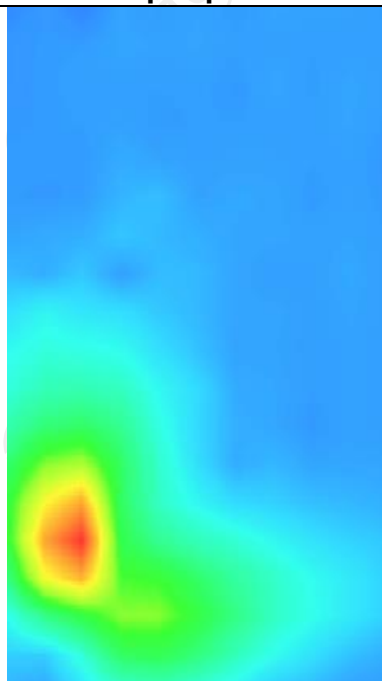
SAR 10g (W/Kg)	0.179053
SAR 1g (W/Kg)	0.464755



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	1.1079	0.5049	0.1560	0.0433	0.0173



Hot spot position



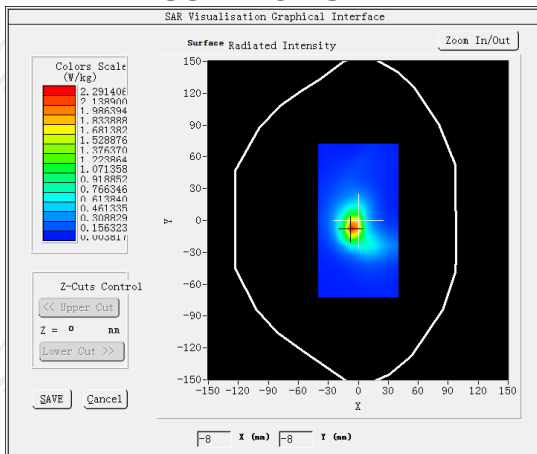
MEASUREMENT 2

Middle Band SAR (Channel 9400):

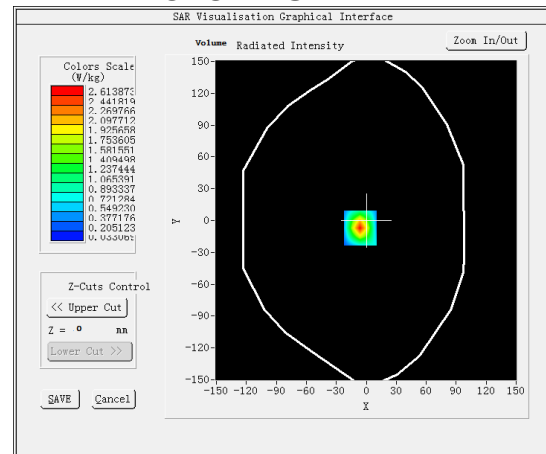
Date: 08/21/2023

Frequency (MHz)	1980.000000
Relative permittivity (real part)	40.000000
Relative permittivity (imaginary part)	13.408000
Conductivity (S/m)	1.400391
Variation (%)	0.470000
Crest Factor	1.0
Probe Conversion factor	2.23
E-Field Probe:	SSE2 (SN 25/22 EPG0375)
Area Scan	<u>dx=8mm dy=8mm, h= 5.00 mm</u>
ZoomScan	<u>5x5x7, dx=8mm dy=8mm</u> <u>dz=5mm, Complete/ndx=8mm dy=8mm, h=</u> <u>5.00 mm</u>
Phantom	<u>Validation plane</u>
Device Position	<u>Body back(0mm)</u>
Band	<u>BAND2 WCDMA1900(hotspot)</u>

SURFACE SAR



VOLUME SAR



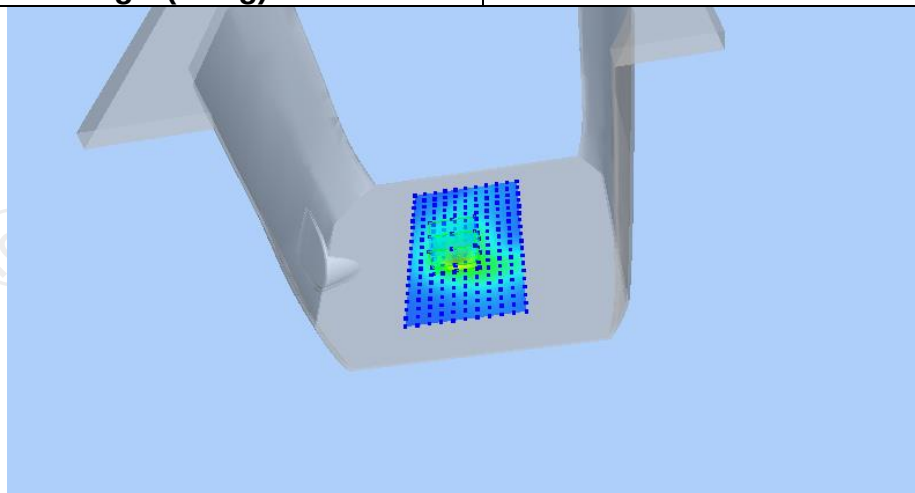
Maximum location: X=-6.00, Y=-7.00 SAR Peak: 1.82 W/kg

SAR 10g (W/Kg)

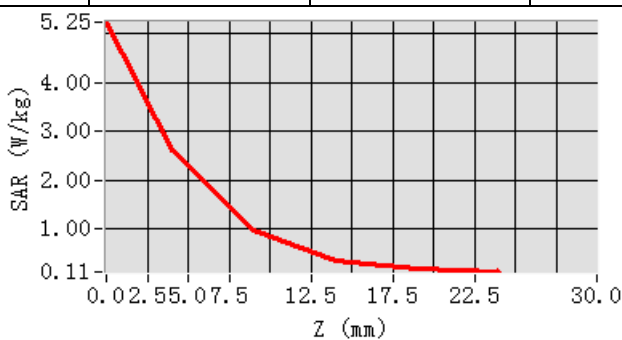
0.490574

SAR 1g (W/Kg)

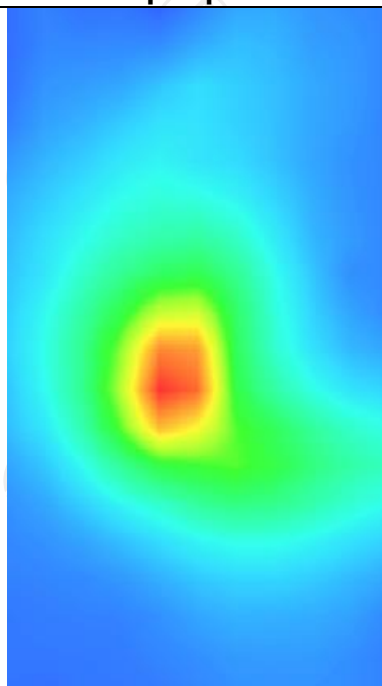
0.537307



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	5.2466	2.6139	0.9719	0.3548	0.1695



Hot spot position



WCDMA Band IV

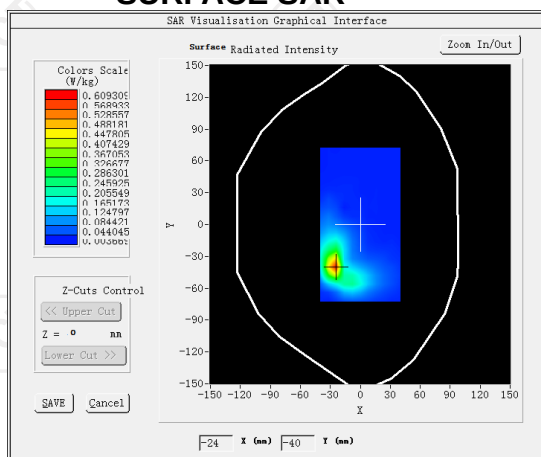
MEASUREMENT 1

Middle Band SAR (Channel 1413):

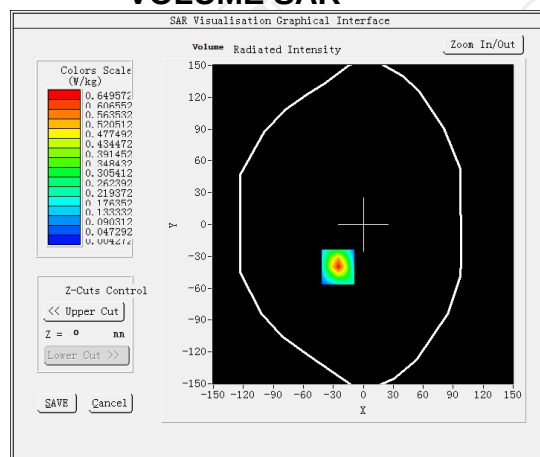
Date: 08/18/2023

Frequency (MHz)	1732.600000
Relative permittivity (real part)	40.116364
Relative permittivity (imaginary part)	14.137455
Conductivity (S/m)	1.360337
Variation (%)	-2.080000
Crest Factor	1.0
Probe Conversion factor	2.08
E-Field Probe:	SSE2 (SN 25/22 EPG0375)
Area Scan	dx=8mm dy=8mm, h= 5.00 mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete/ndx=8mm dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Body back(0mm)
Band	BAND4 WCDMA1700

SURFACE SAR

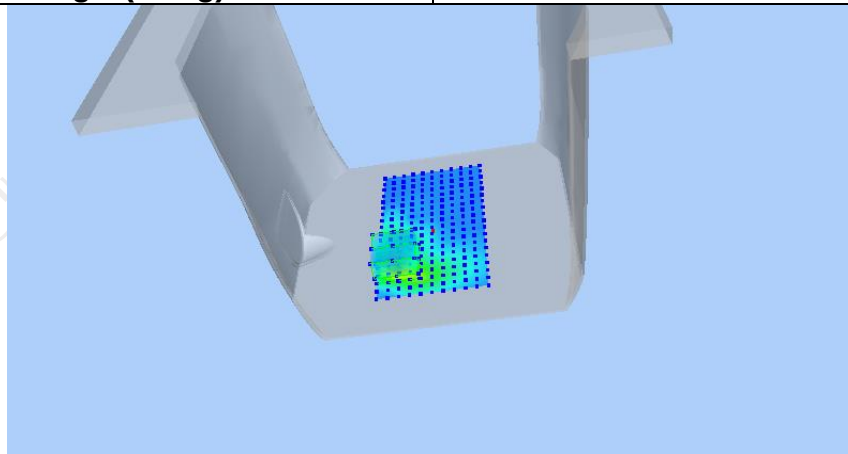


VOLUME SAR

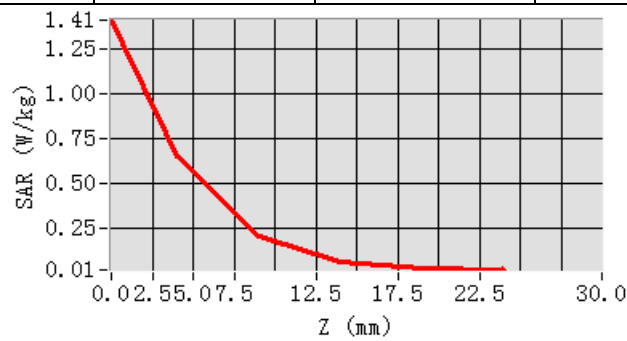


Maximum location: X=-25.00, Y=-40.00 SAR Peak:1.41 W/kg

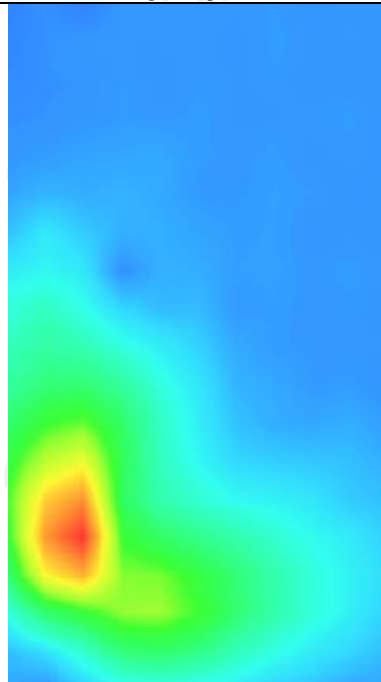
SAR 10g (W/Kg)	0.241975
SAR 1g (W/Kg)	0.605059



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	1.4087	0.6496	0.2050	0.0575	0.0217



Hot spot position



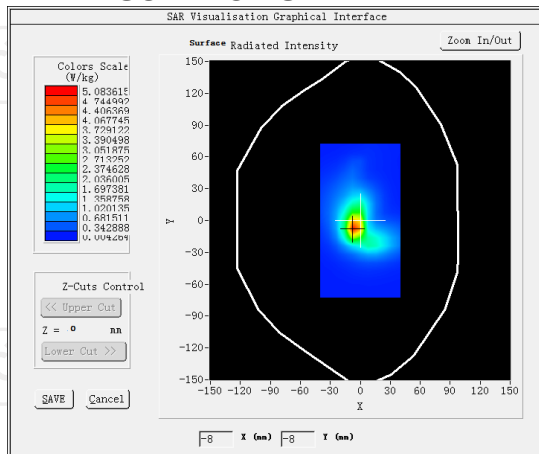
MEASUREMENT 2

Middle Band SAR (Channel 1413):

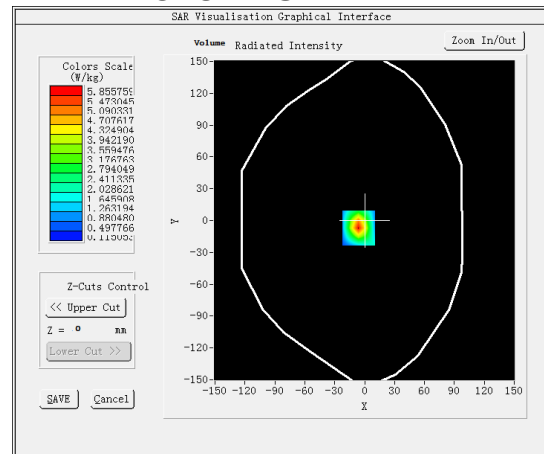
Date: 08/18/2023

Frequency (MHz)	1732.600000
Relative permittivity (real part)	40.116364
Relative permittivity (imaginary part)	14.137455
Conductivity (S/m)	1.360337
Variation (%)	0.490000
Crest Factor	1.0
Probe Conversion factor	2.08
E-Field Probe:	SSE2 (SN 25/22 EPG0375)
Area Scan	<u>dx=8mm dy=8mm, h= 5.00 mm</u>
ZoomScan	<u>5x5x7, dx=8mm dy=8mm</u> <u>dz=5mm, Complete/ndx=8mm dy=8mm, h=</u> <u>5.00 mm</u>
Phantom	<u>Validation plane</u>
Device Position	<u>Body back(hotspot 0mm)</u>
Band	<u>BAND4 WCDMA1700</u>

SURFACE SAR

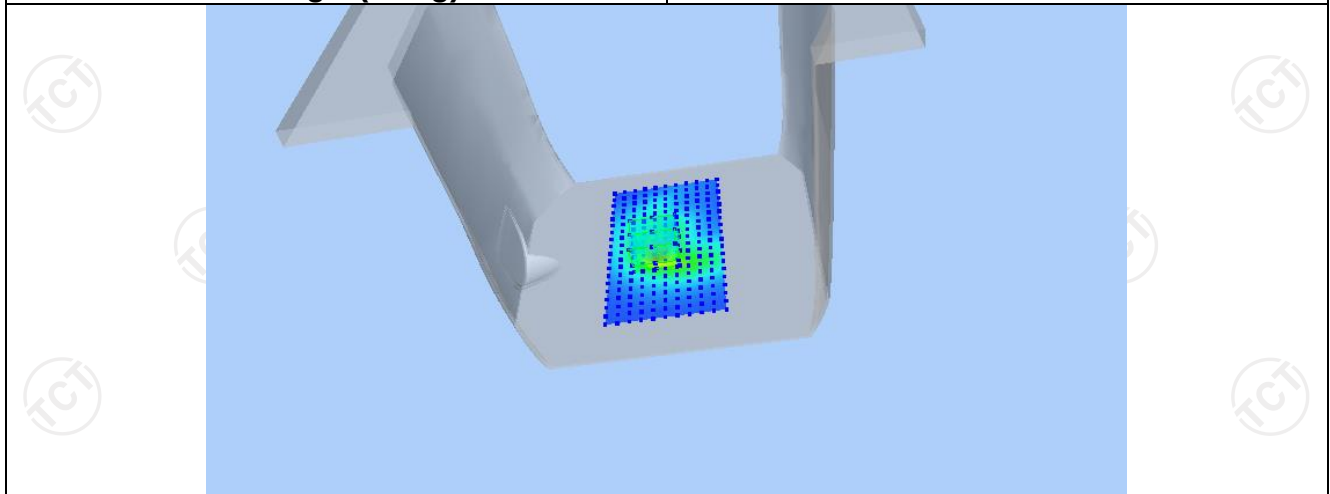


VOLUME SAR

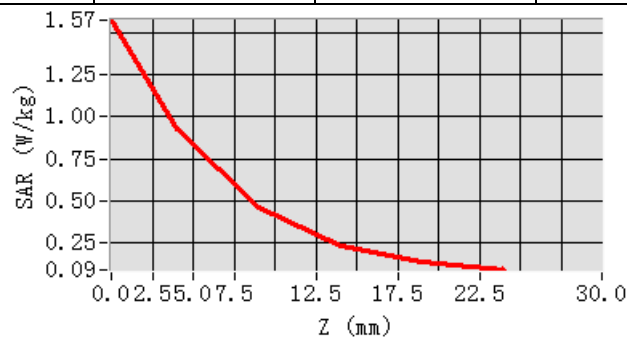


Maximum location: X=-6.00, Y=-7.00 SAR Peak: 1.58 W/kg

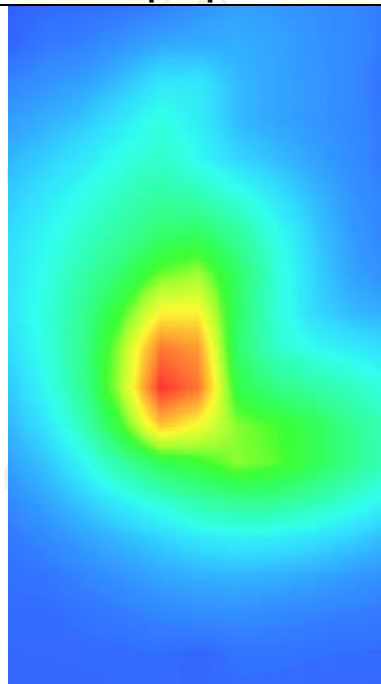
SAR 10g (W/Kg)	0.425613
SAR 1g (W/Kg)	0.652592



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	1.5712	0.9221	0.4576	0.2360	0.1406



Hot spot position



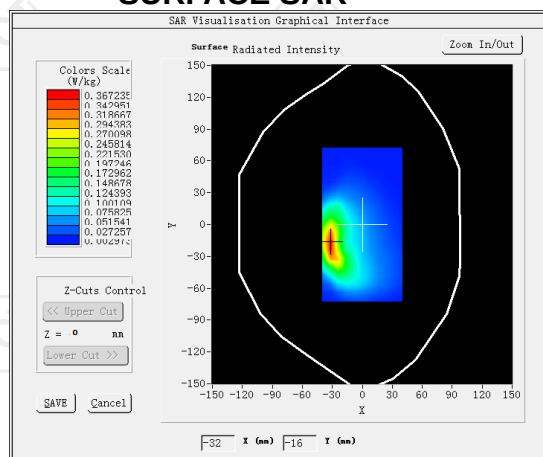
WCDMA Band V MEASUREMENT 1

High Band SAR (Channel 4233):

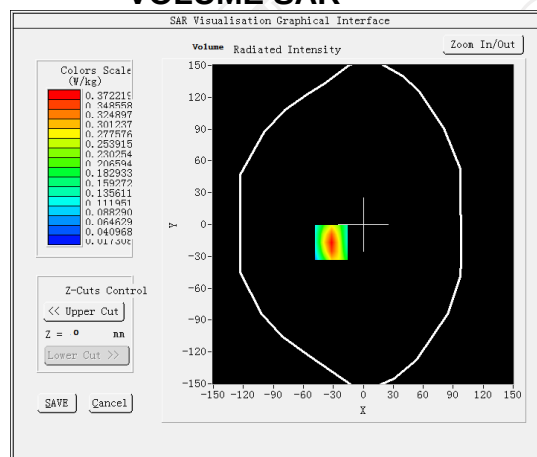
Date: 08/16/2023

Frequency (MHz)	846.600000
Relative permittivity (real part)	41.500000
Relative permittivity (imaginary part)	19.400000
Conductivity (S/m)	0.901453
Variation (%)	-4.000000
Crest Factor:	1.0
Probe Conversion factor	1.80
E-Field Probe:	SSE2 (SN 25/22 EPG0375)
Area Scan	dx=8mm dy=8mm, h= 5.00 mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete/ndx=8mm dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Body back(0mm)
Band	BAND5 WCDMA850

SURFACE SAR



VOLUME SAR



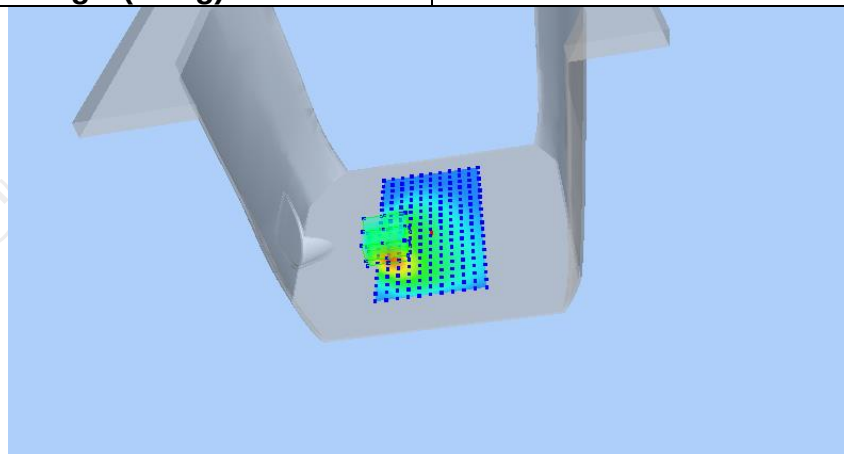
Maximum location: X=-32.00, Y=-17.00 SAR Peak: 0.63 W/kg

SAR 10g (W/Kg)

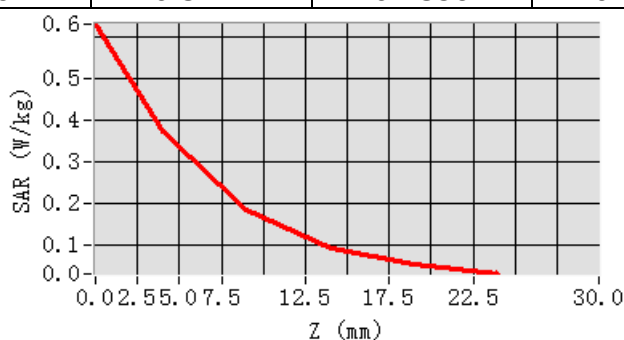
0.177050

SAR 1g (W/Kg)

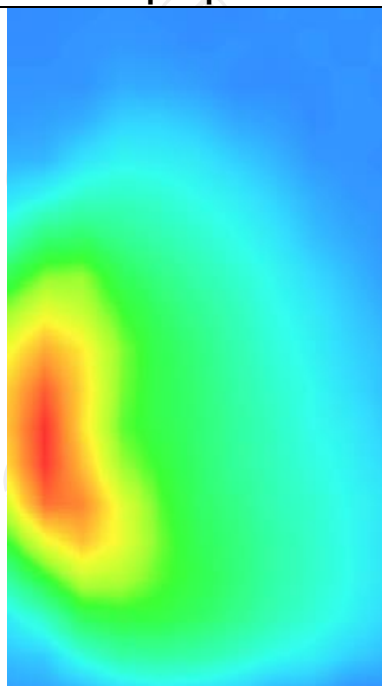
0.346232



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.6294	0.3722	0.1856	0.0943	0.0533



Hot spot position



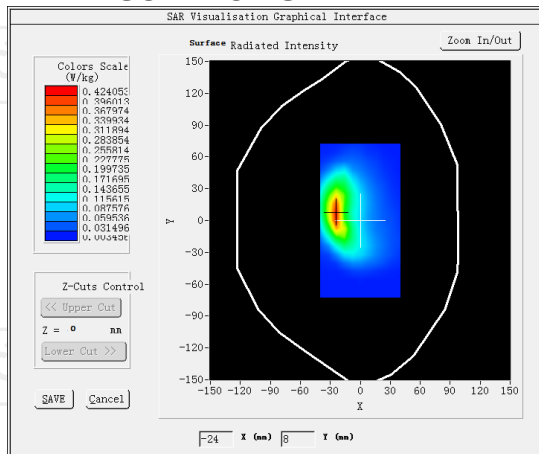
MEASUREMENT 2

High Band SAR (Channel 4233):

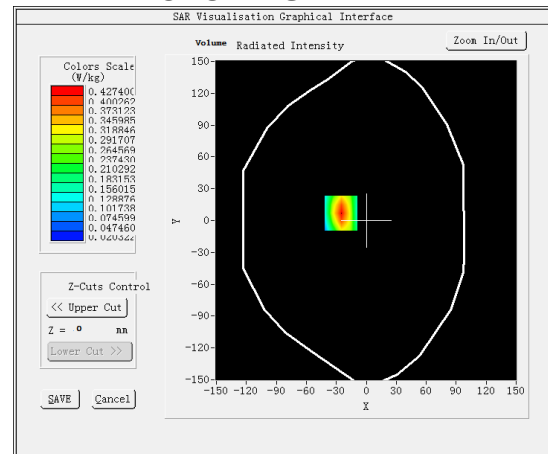
Date: 08/16/2023

Frequency (MHz)	846.600000
Relative permittivity (real part)	41.500000
Relative permittivity (imaginary part)	19.400000
Conductivity (S/m)	0.901453
Variation (%)	-2.340000
Crest Factor:	1.0
Probe Conversion factor	1.80
E-Field Probe:	SSE2 (SN 25/22 EPG0375)
Area Scan	<u>dx=8mm dy=8mm, h= 5.00 mm</u>
ZoomScan	<u>5x5x7,dx=8mm dy=8mm</u> <u>dz=5mm,Complete/ndx=8mm dy=8mm, h=</u> <u>5.00 mm</u>
Phantom	<u>Validation plane</u>
Device Position	<u>Body back(0mm)</u>
Band	<u>BAND5 WCDMA850(hotspot)</u>

SURFACE SAR

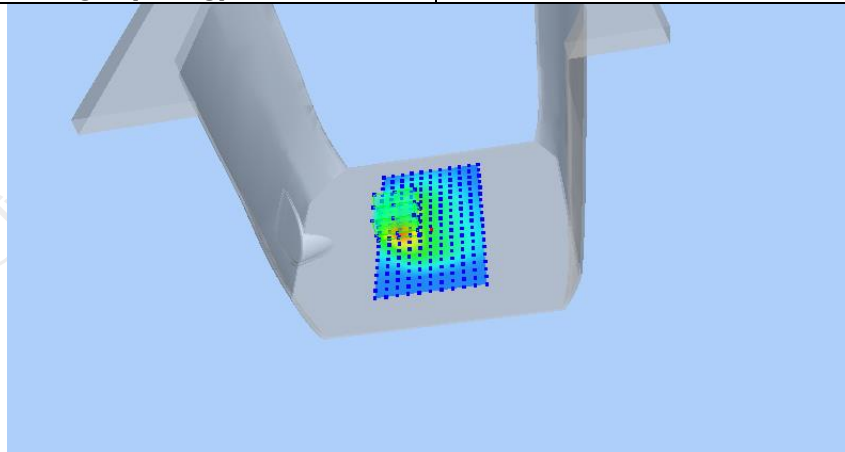


VOLUME SAR

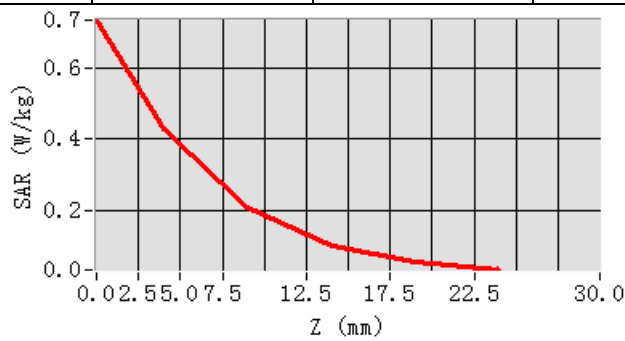


Maximum location: X=-10.00, Y=0.00 SAR Peak:0.69 W/kg

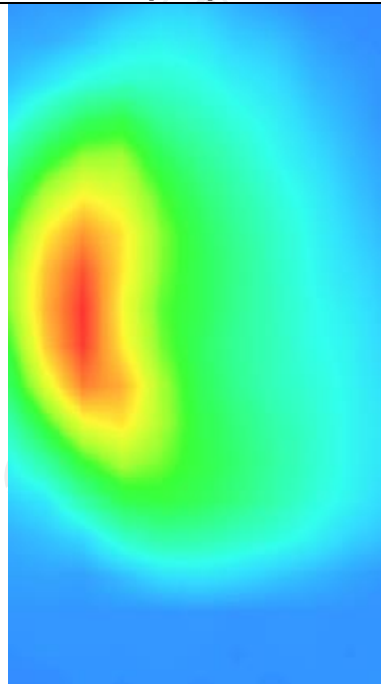
SAR 10g (W/Kg)	0.201656
SAR 1g (W/Kg)	0.397496



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.7325	0.4274	0.2090	0.1045	0.0591



Hot spot position



LTE Band 2

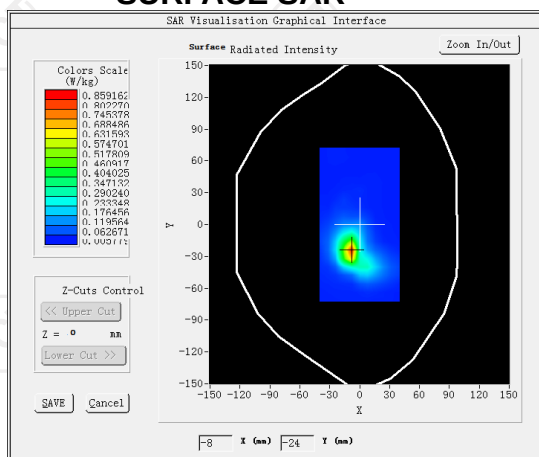
MEASUREMENT 1

Middle Band SAR (Channel 18900):

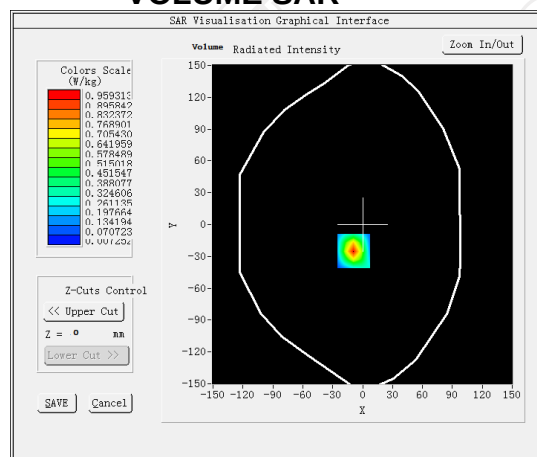
Date: 08/21/2023

Frequency (MHz)	1880.000000
Relative permittivity (real part)	40.000000
Relative permittivity (imaginary part)	13.411700
Conductivity (S/m)	1.400405
Variation (%)	-4.220000
Crest Factor	1.0
Probe Conversion factor	2.23
E-Field Probe:	SSE2 (SN 25/22 EPG0375)
Area Scan	dx=8mm dy=8mm, h= 5.00 mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete/ndx=8mm dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Body back(0mm)
Band	LTE band 2 (1 RB#49)

SURFACE SAR

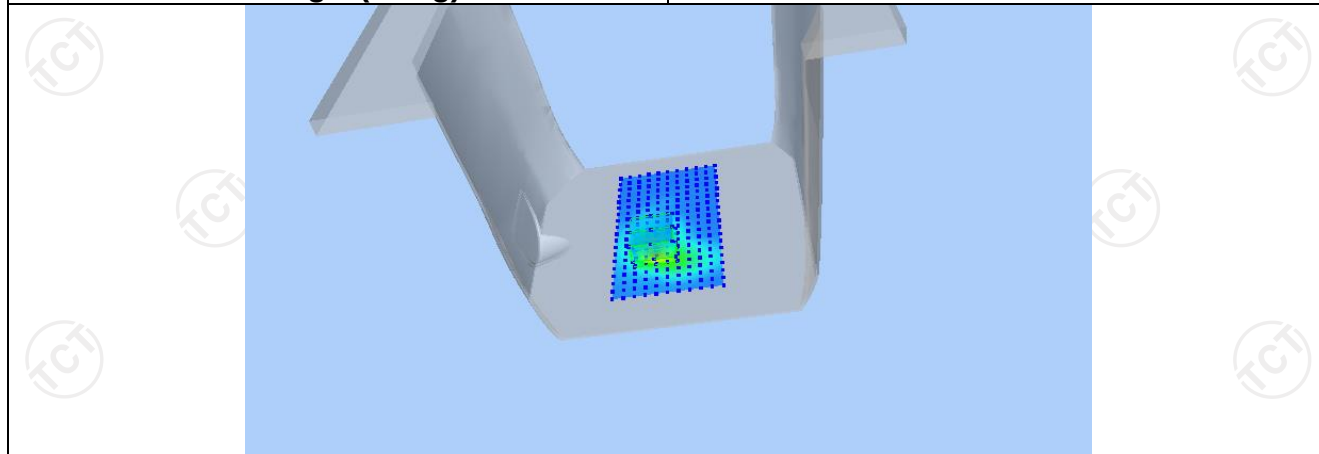


VOLUME SAR

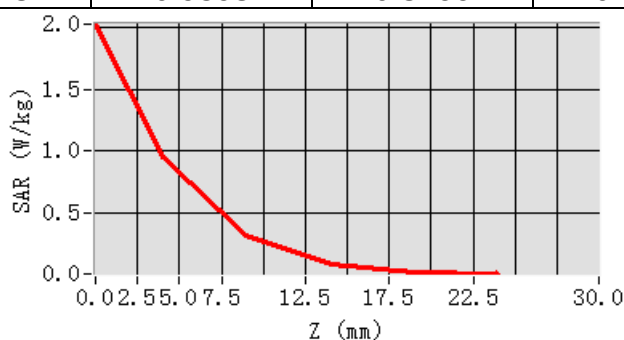


Maximum location: X=-9.00, Y=-25.00 SAR Peak: 2.01 W/kg

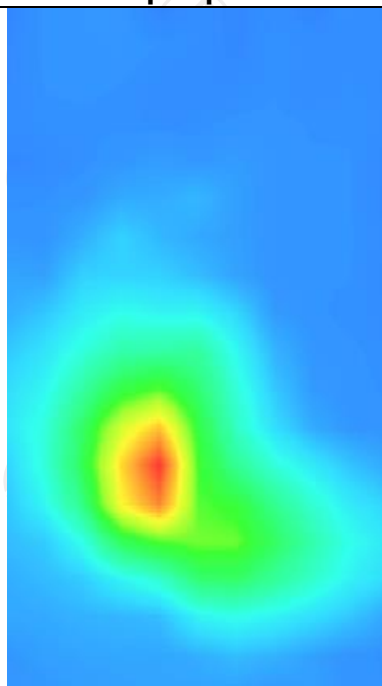
SAR 10g (W/Kg)	0.341630
SAR 1g (W/Kg)	0.875747



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	2.0243	0.9593	0.3166	0.0901	0.0289



Hot spot position



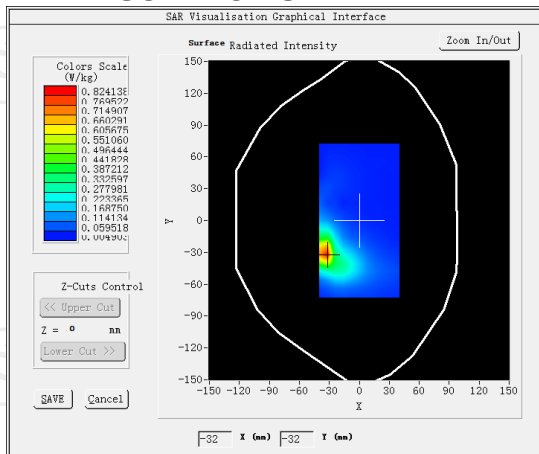
MEASUREMENT 2

Middle Band SAR (Channel 18900):

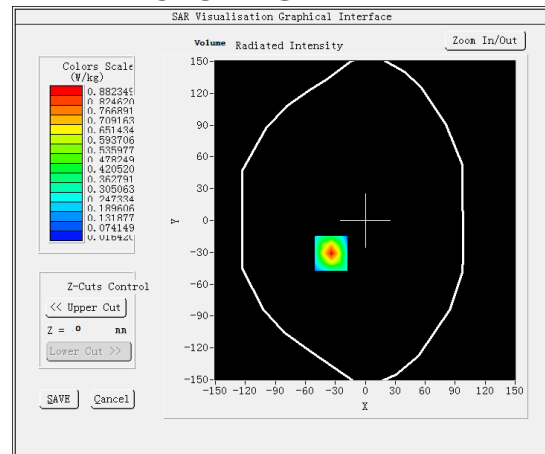
Date: 08/21/2023

Frequency (MHz)	1880.000000
Relative permittivity (real part)	40.000000
Relative permittivity (imaginary part)	13.411700
Conductivity (S/m)	1.400405
Variation (%)	3.770000
Crest Factor	1.0
Probe Conversion factor	2.23
E-Field Probe:	SSE2 (SN 25/22 EPG0375)
Area Scan	<u>dx=8mm dy=8mm, h= 5.00 mm</u>
ZoomScan	<u>5x5x7,dx=8mm dy=8mm</u> <u>dz=5mm,Complete/ndx=8mm dy=8mm, h=</u> <u>5.00 mm</u>
Phantom	<u>Validation plane</u>
Device Position	<u>Body back(hotspot 0mm)</u>
Band	<u>LTE band 2 (1 RB#49)</u>

SURFACE SAR

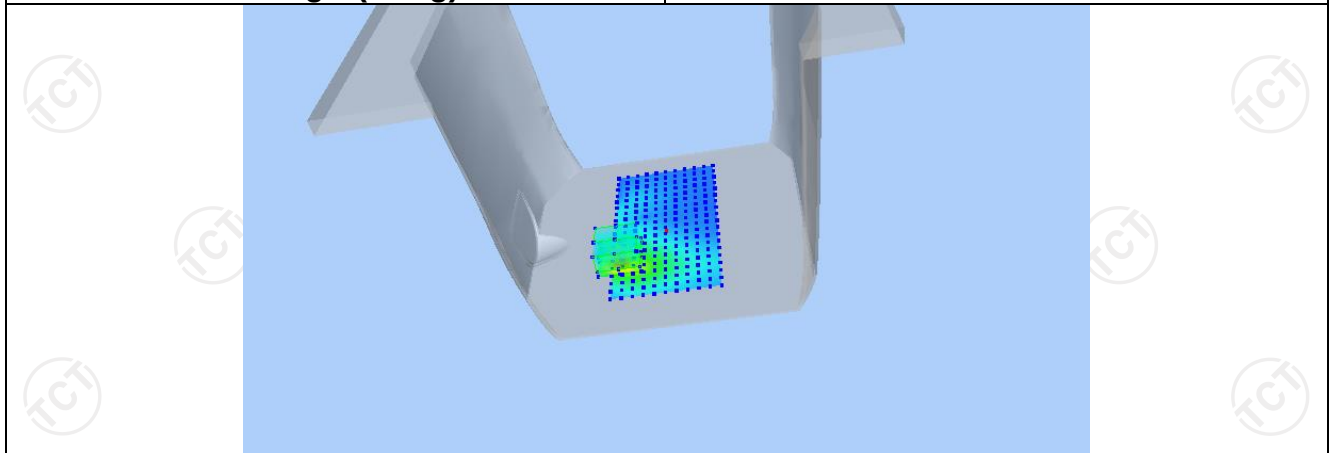


VOLUME SAR

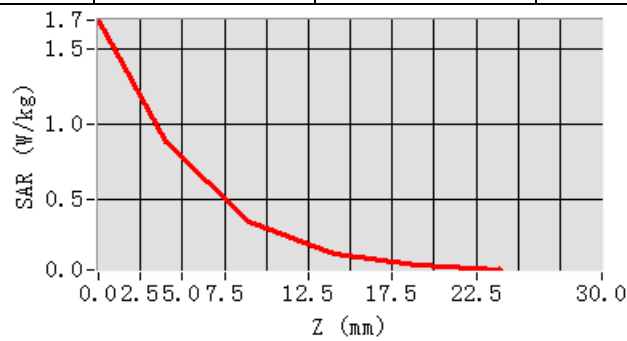


Maximum location: X=-34.00, Y=-31.00 SAR Peak: 1.69W/kg

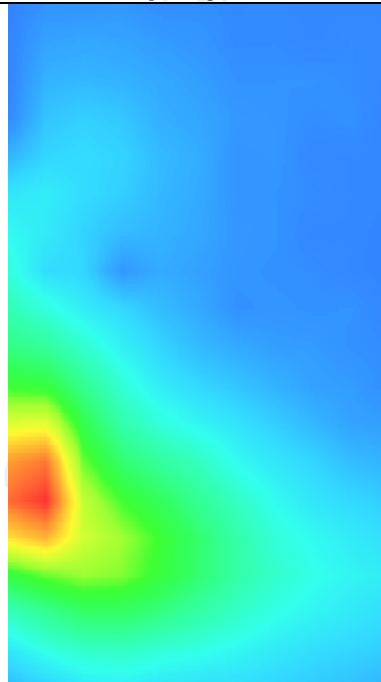
SAR 10g (W/Kg)	0.352098
SAR 1g (W/Kg)	0.807464



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	1.6891	0.8823	0.3569	0.1426	0.0690



Hot spot position

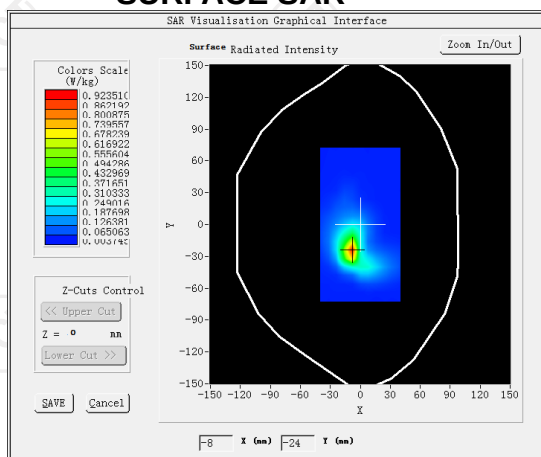


LTE Band 4

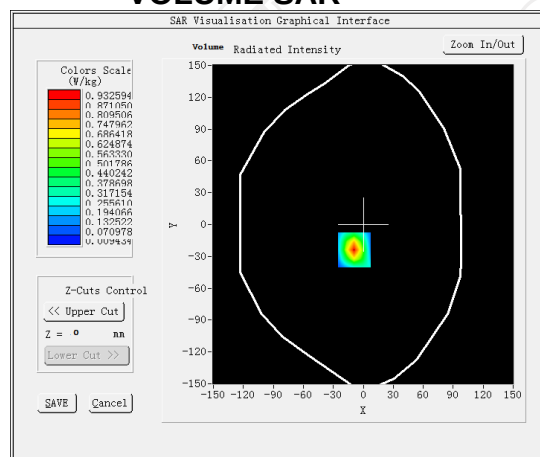
MEASUREMENT 1

Low Band SAR (Channel 20050):		Date: 08/18/2023
Frequency (MHz)	1720.000000	
Relative permittivity (real part)	40.115910	
Relative permittivity (imaginary part)	14.136136	
Conductivity (S/m)	1.360603	
Variation (%)	-4.200000	
Crest Factor	1.0	
Probe Conversion factor	2.08	
E-Field Probe:	SSE2 (SN 25/22 EPG0375)	
Area Scan	dx=8mm dy=8mm, h= 5.00 mm	
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete/ndx=8mm dy=8mm, h= 5.00 mm	
Phantom	Validation plane	
Device Position	Body back(0mm)	
Band	LTE band 4(1 RB#49)	

SURFACE SAR



VOLUME SAR



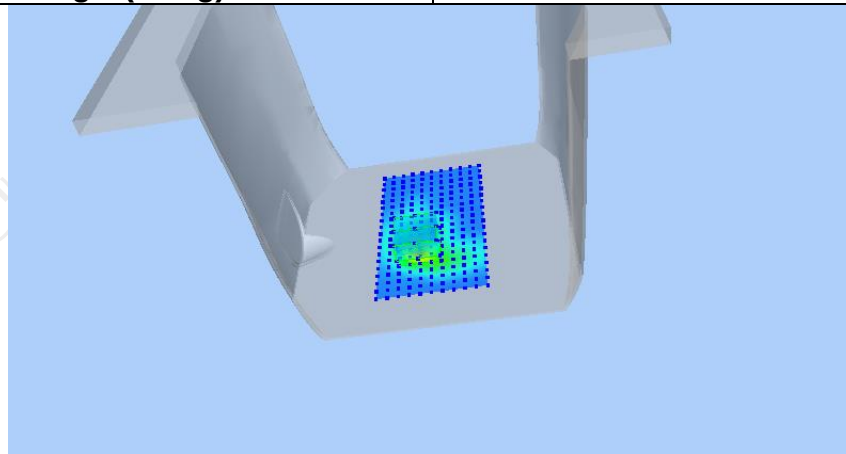
Maximum location: X=-9.00, Y=-24.00 SAR Peak: 1.96 W/kg

SAR 10g (W/Kg)

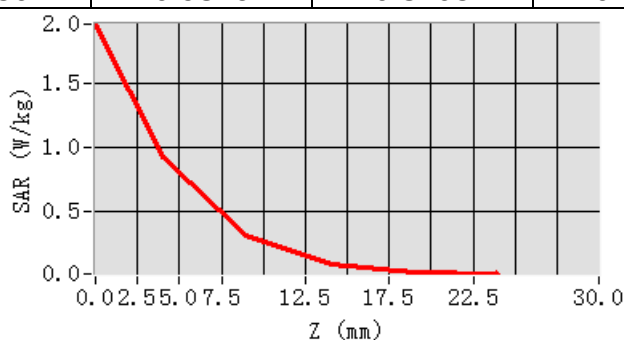
0.337766

SAR 1g (W/Kg)

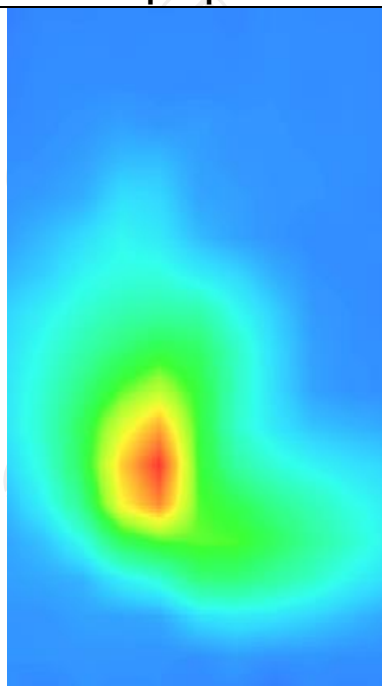
0.853653



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	1.9650	0.9326	0.3105	0.0919	0.0328



Hot spot position



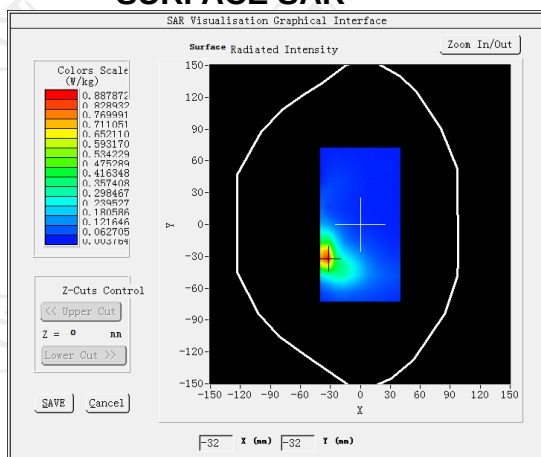
MEASUREMENT 2

Low Band SAR (Channel 20050):

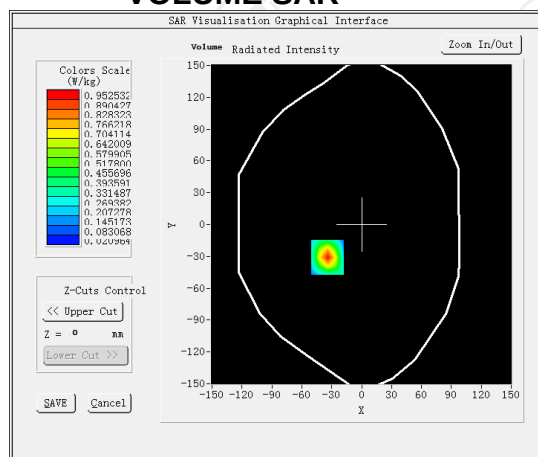
Date: 08/18/2023

Frequency (MHz)	1720.000000
Relative permittivity (real part)	40.115910
Relative permittivity (imaginary part)	14.136136
Conductivity (S/m)	1.360603
Variation (%)	4.880000
Crest Factor	1.0
Probe Conversion factor	2.08
E-Field Probe:	SSE2 (SN 25/22 EPG0375)
Area Scan	dx=8mm dy=8mm, h= 5.00 mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete/ndx=8mm dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Body back(hotspot 0mm)
Band	LTE band 4(1 RB#49)

SURFACE SAR

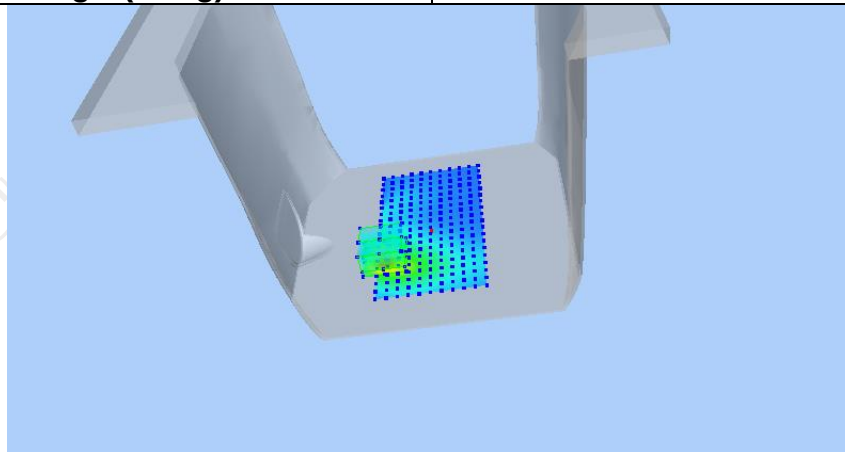


VOLUME SAR

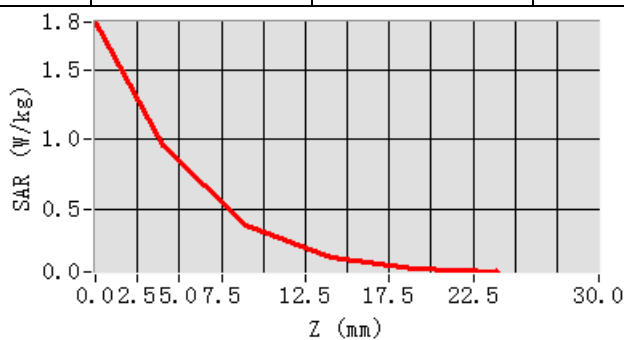


Maximum location: X=-34.00, Y=-31.00 SAR Peak: 1.84 W/kg

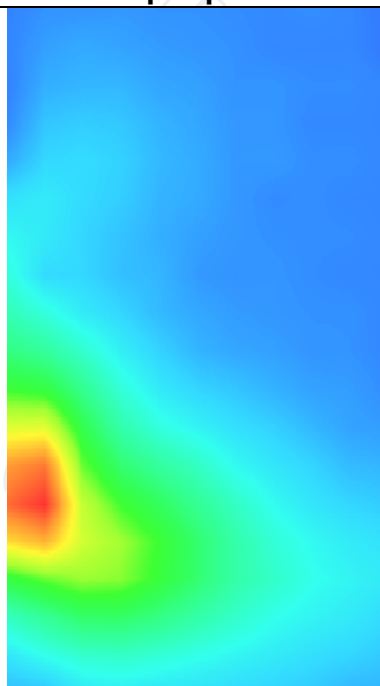
SAR 10g (W/Kg)	0.380030
SAR 1g (W/Kg)	0.872109



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	1.8449	0.9525	0.3784	0.1497	0.0742



Hot spot position



LTE Band 5

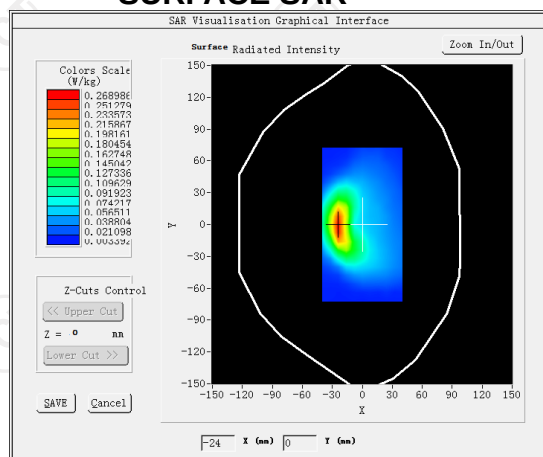
MEASUREMENT 1

High Band SAR (Channel 20600):

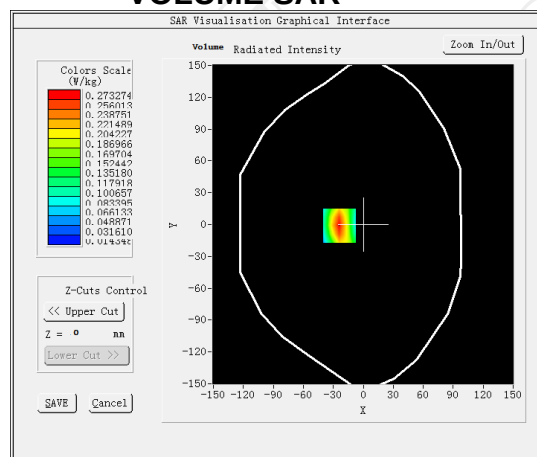
Date: 08/16/2023

Frequency (MHz)	844.000000
Relative permittivity (real part)	41.500000
Relative permittivity (imaginary part)	19.400000
Conductivity (S/m)	0.901561
Variation (%)	-4.080000
Crest Factor	1.0
Probe Conversion factor	1.80
E-Field Probe:	SSE2 (SN 25/22 EPG0375)
Area Scan	dx=8mm dy=8mm, h= 5.00 mm
ZoomScan	5x5x7, dx=8mm dy=8mm dz=5mm, Complete/ndx=8mm dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Body back(0mm)
Band	LTE band 5(1 RB#0)

SURFACE SAR



VOLUME SAR



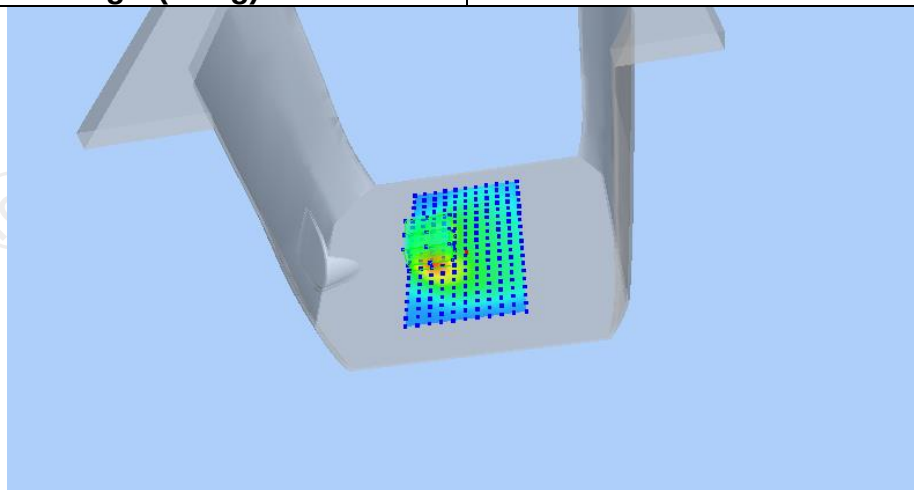
Maximum location: X=-24.00, Y=-1.00 SAR Peak: 0.45W/kg

SAR 10g (W/Kg)

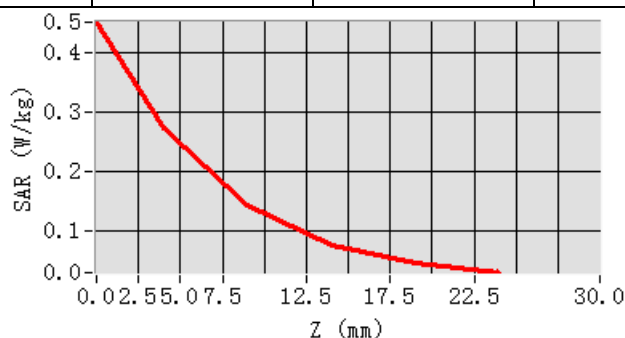
0.134141

SAR 1g (W/Kg)

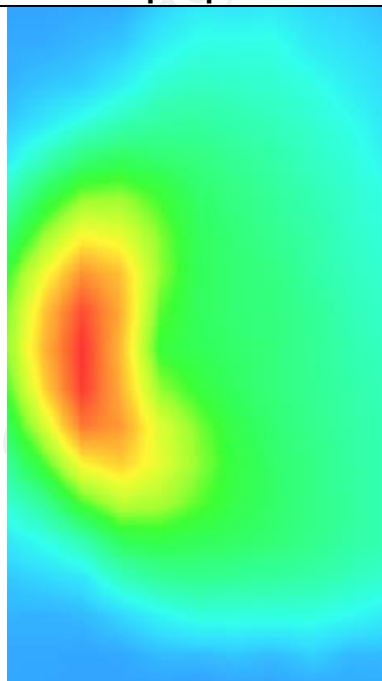
0.253854



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.4512	0.2733	0.1420	0.0762	0.0458



Hot spot position



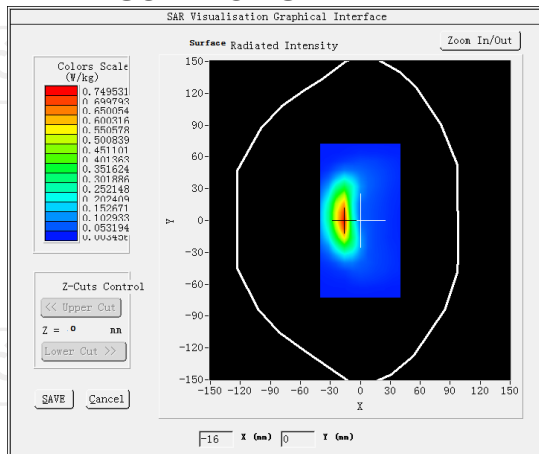
MEASUREMENT 2

High Band SAR (Channel 20600):

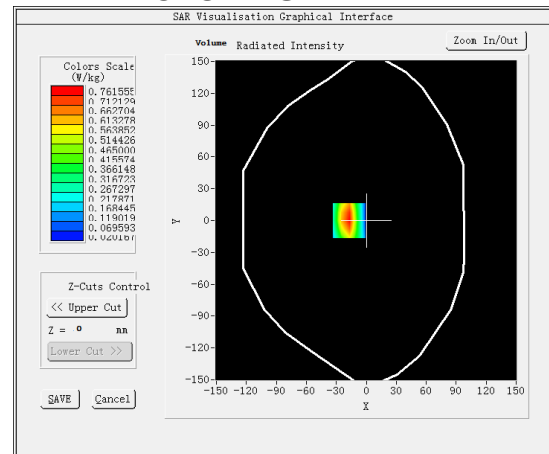
Date: 08/16/2023

Frequency (MHz)	844.000000
Relative permittivity (real part)	41.500000
Relative permittivity (imaginary part)	19.400000
Conductivity (S/m)	0.901561
Variation (%)	3.820000
Crest Factor	1.0
Probe Conversion factor	1.80
E-Field Probe:	SSE2 (SN 25/22 EPG0375)
Area Scan	<u>dx=8mm dy=8mm, h= 5.00 mm</u>
ZoomScan	<u>5x5x7,dx=8mm dy=8mm</u> <u>dz=5mm,Complete/ndx=8mm dy=8mm, h=</u> <u>5.00 mm</u>
Phantom	<u>Validation plane</u>
Device Position	<u>Body back((hotspot 10mm)</u>
Band	<u>LTE band 5(1 RB#0)</u>

SURFACE SAR

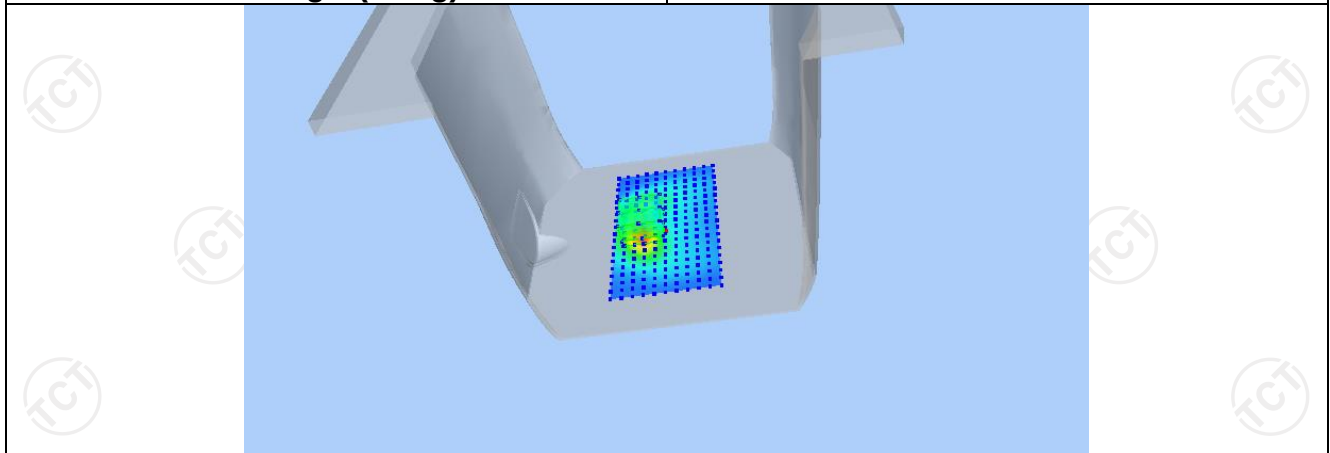


VOLUME SAR

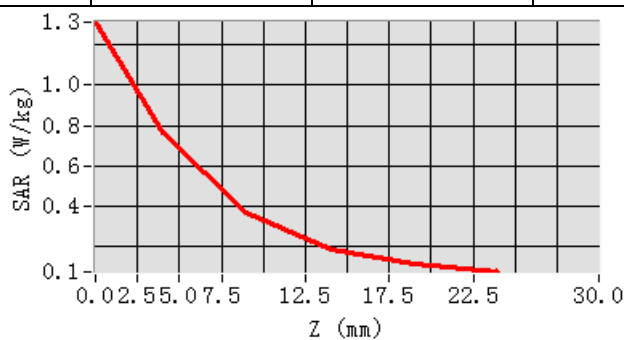


Maximum location: X=-17.00, Y=0.00 SAR Peak: 1.33 W/kg

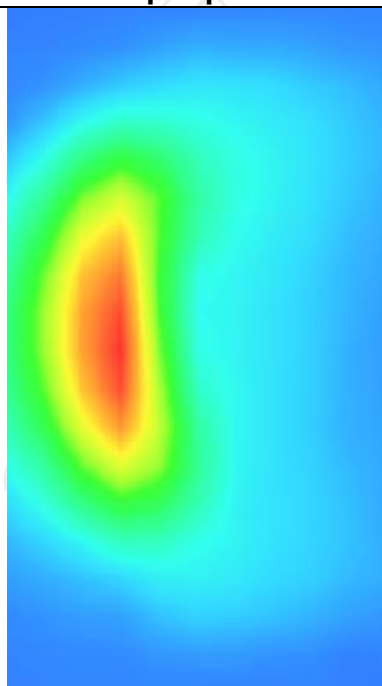
SAR 10g (W/Kg)	0.356548
SAR 1g (W/Kg)	0.303023



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	1.3117	0.7616	0.3719	0.1892	0.1126



Hot spot position



LTE Band 12

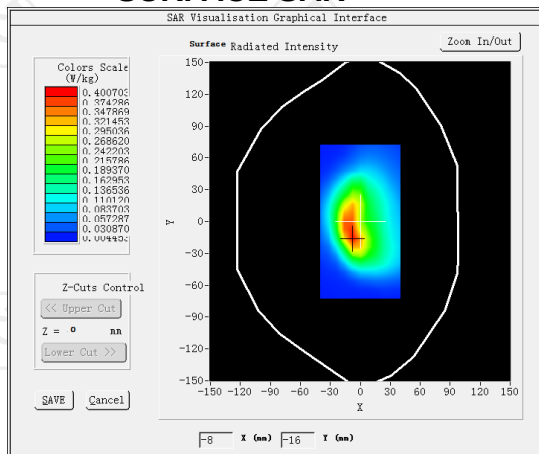
MEASUREMENT 1

High Band SAR (Channel 23130):

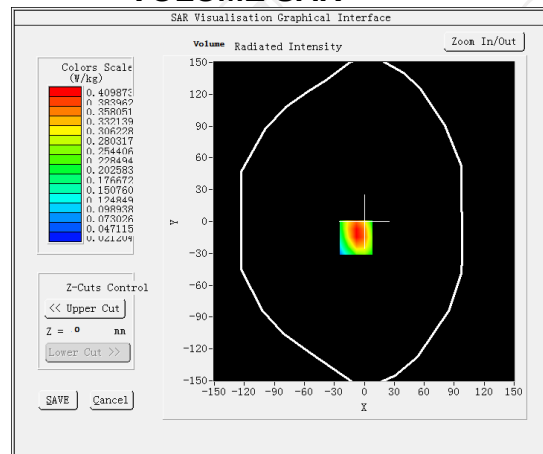
Date: 08/14/2023

Frequency (MHz)	711.000000
Relative permittivity (real part)	42.126667
Relative permittivity (imaginary part)	23.264000
Conductivity (S/m)	0.914404
Variation (%)	-2.160000
Crest Factor	1.0
Probe Conversion factor	1.71
E-Field Probe:	SSE2 (SN 25/22 EPG0375)
Area Scan	dx=8mm dy=8mm, h= 5.00 mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete/ndx=8mm dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Body back(0mm)
Band	LTE band 12(1 RB#24)

SURFACE SAR

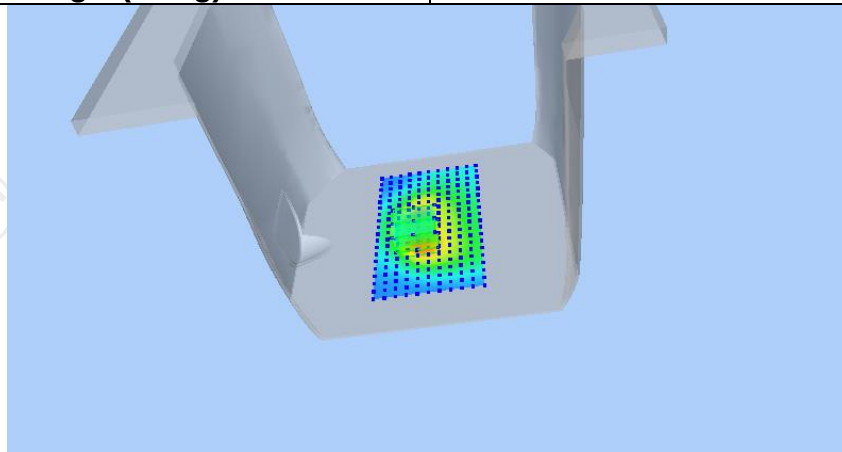


VOLUME SAR

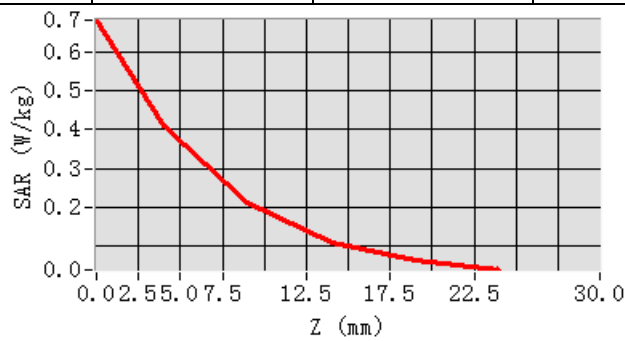


Maximum location: X=-8.00, Y=-15.00 SAR Peak:0.70 W/kg

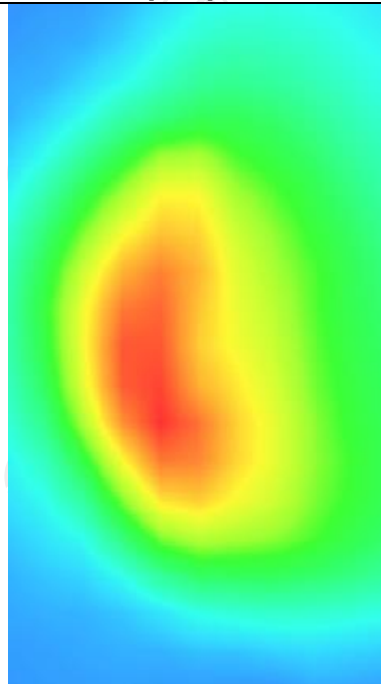
SAR 10g (W/Kg)	0.217284
SAR 1g (W/Kg)	0.401828



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.6801	0.4099	0.2107	0.1109	0.0647



Hot spot position



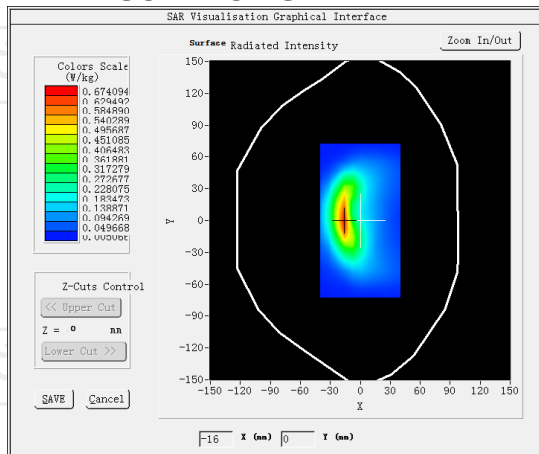
MEASUREMENT 2

High Band SAR (Channel 23130):

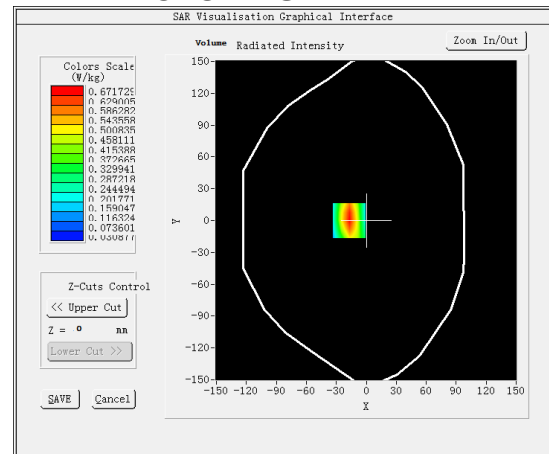
Date: 08/14/2023

Frequency (MHz)	711.000000
Relative permittivity (real part)	42.126667
Relative permittivity (imaginary part)	23.264000
Conductivity (S/m)	0.914404
Variation (%)	2.640000
Crest Factor	1.0
Probe Conversion factor	1.71
E-Field Probe:	SSE2 (SN 25/22 EPG0375)
Area Scan	<u>dx=8mm dy=8mm, h= 5.00 mm</u>
ZoomScan	<u>5x5x7,dx=8mm dy=8mm</u> <u>dz=5mm,Complete/ndx=8mm dy=8mm, h=</u> <u>5.00 mm</u>
Phantom	<u>Validation plane</u>
Device Position	<u>Body back(hotspot 0mm)</u>
Band	<u>LTE band 12(1 RB#24)</u>

SURFACE SAR

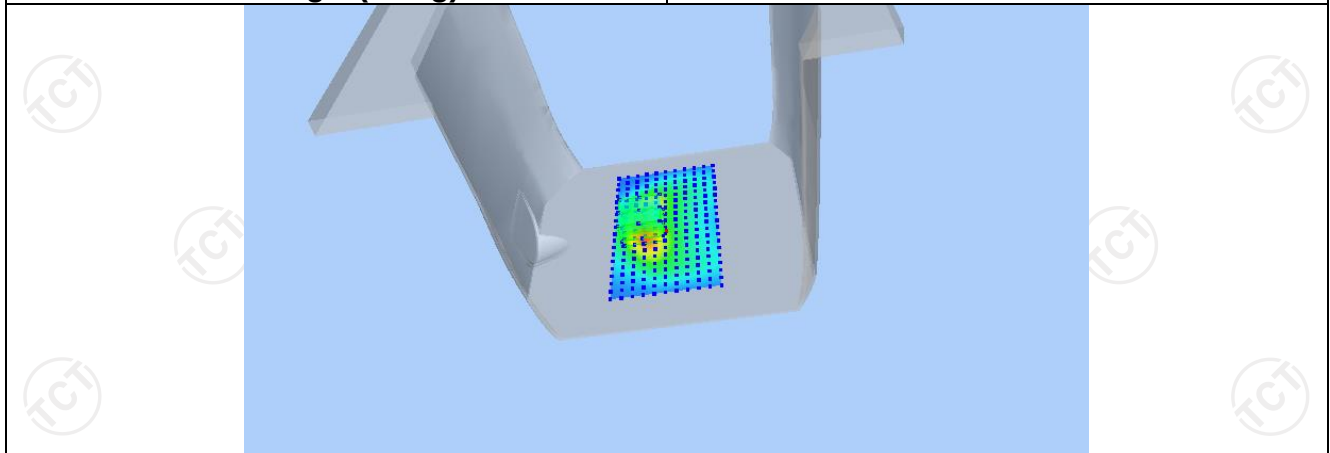


VOLUME SAR

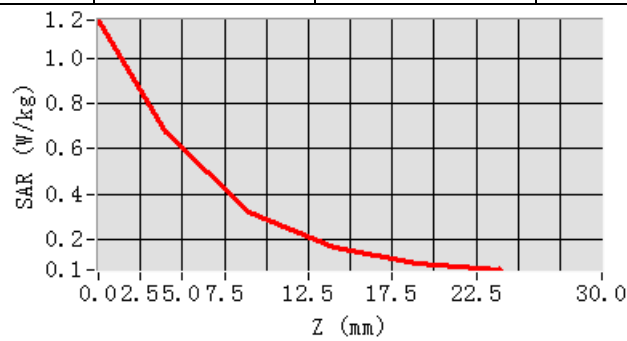


Maximum location: X=-17.00, Y=0.00 SAR Peak: 1.18W/kg

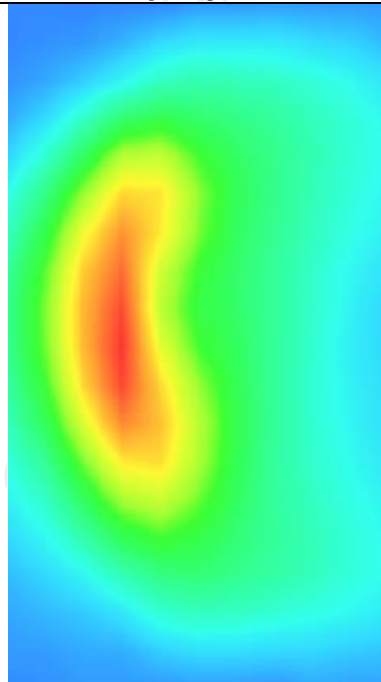
SAR 10g (W/Kg)	0.326643
SAR 1g (W/Kg)	0.541629



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	1.1685	0.6717	0.3234	0.1630	0.0975



Hot spot position

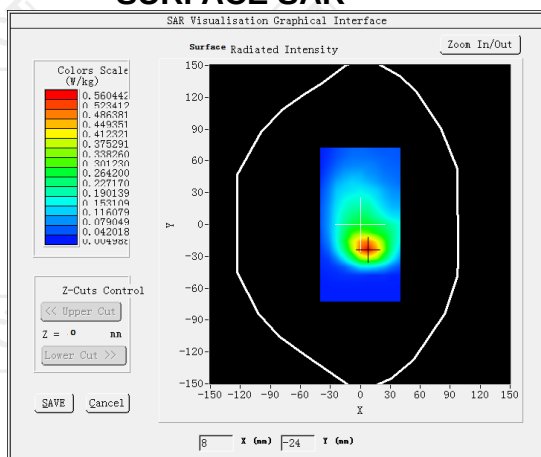


LTE Band 41

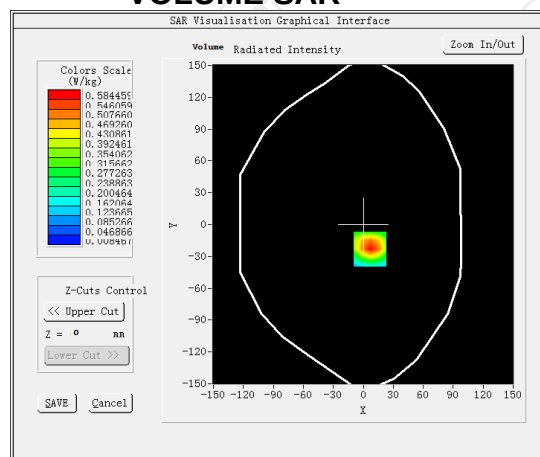
MEASUREMENT 1

High Band SAR (Channel 40490):		Date: 08/24/2023
Frequency (MHz)	2680.000000	
Relative permittivity (real part)	42.126667	
Relative permittivity (imaginary part)	23.264000	
Conductivity (S/m)	0.914404	
Variation (%)	4.960000	
Crest Factor	1.0	
Probe Conversion factor	4.36	
E-Field Probe:	SSE2 (SN 25/22 EPG0375)	
Area Scan	dx=8mm dy=8mm, h= 5.00 mm	
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete/ndx=8mm dy=8mm, h= 5.00 mm	
Phantom	Validation plane	
Device Position	Body back(0mm)	
Band	LTE band 41(1 RB#99)	

SURFACE SAR

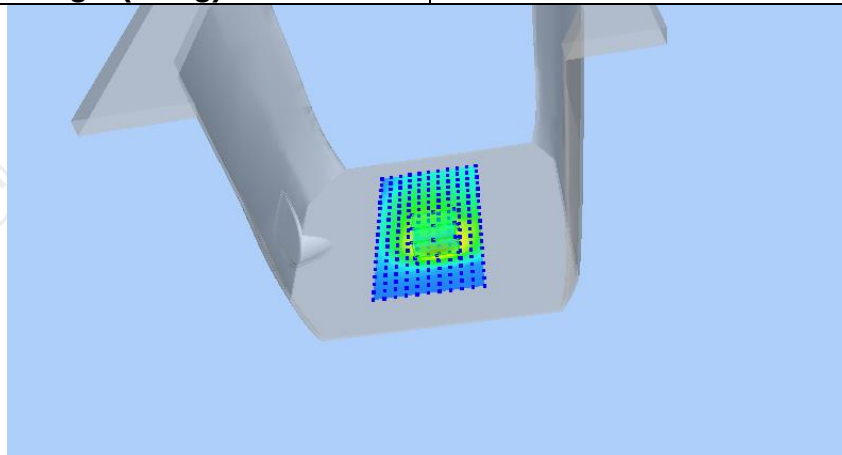


VOLUME SAR

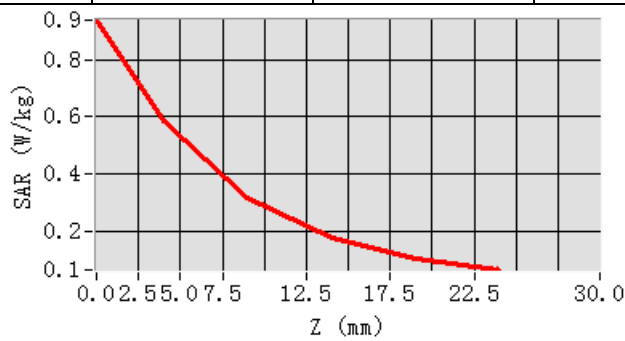


Maximum location: X=7.00, Y=-23.00 SAR Peak: 0.94 W/kg

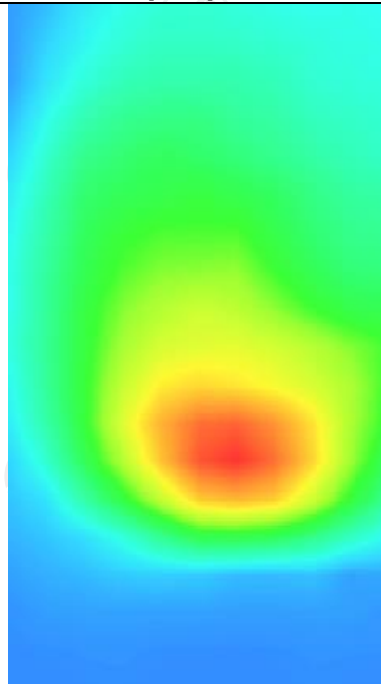
SAR 10g (W/Kg)	0.303978
SAR 1g (W/Kg)	0.600031



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.9365	0.5845	0.3170	0.1765	0.1073



Hot spot position



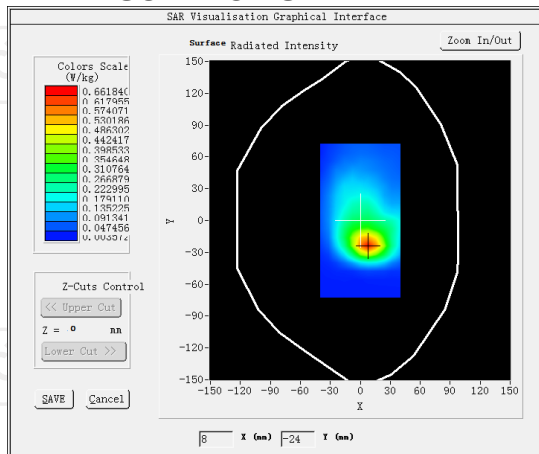
MEASUREMENT 2

High Band SAR (Channel 40490):

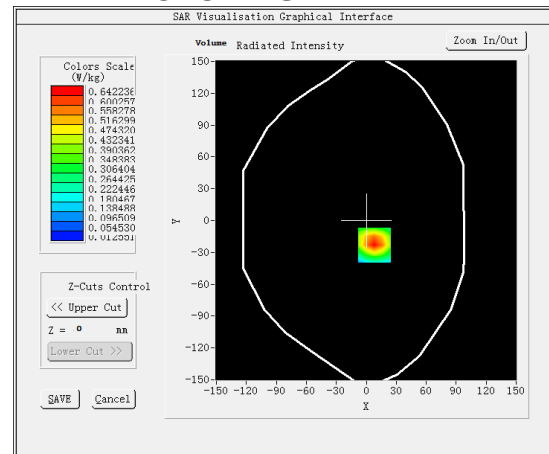
Date: 08/24/2023

Frequency (MHz)	2680.000000
Relative permittivity (real part)	42.126667
Relative permittivity (imaginary part)	23.264000
Conductivity (S/m)	0.914404
Variation (%)	-2.960000
Crest Factor	1.0
Probe Conversion factor	4.36
E-Field Probe:	SSE2 (SN 25/22 EPG0375)
Area Scan	<u>dx=8mm dy=8mm, h= 5.00 mm</u>
ZoomScan	<u>5x5x7,dx=8mm dy=8mm</u> <u>dz=5mm,Complete/ndx=8mm dy=8mm, h=</u> <u>5.00 mm</u>
Phantom	Validation plane
Device Position	<u>Body back(hotspot 0mm)</u>
Band	<u>LTE band 41(1 RB#99)</u>

SURFACE SAR

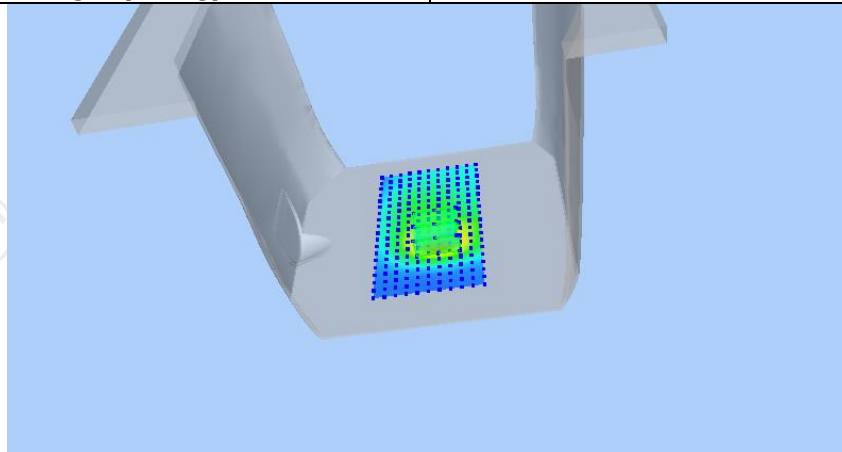


VOLUME SAR

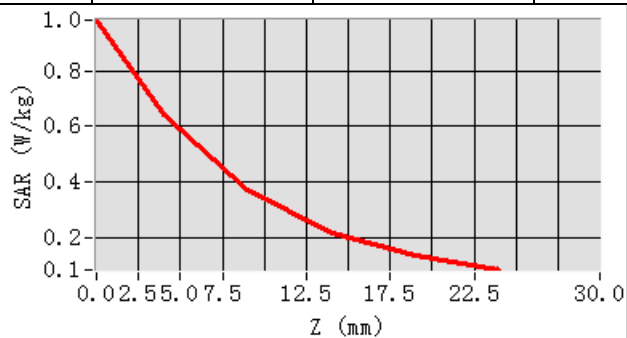


Maximum location: X=8.00, Y=-25.00 SAR Peak: 0.99 W/kg

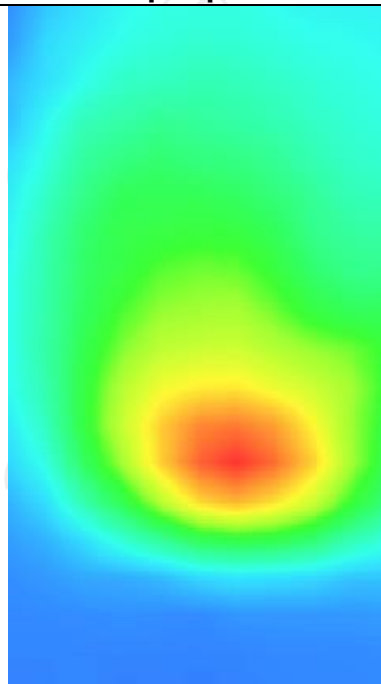
SAR 10g (W/Kg)	0.344124
SAR 1g (W/Kg)	0.693915



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.9835	0.6422	0.3704	0.2169	0.1338



Hot spot position



LTE Band 66

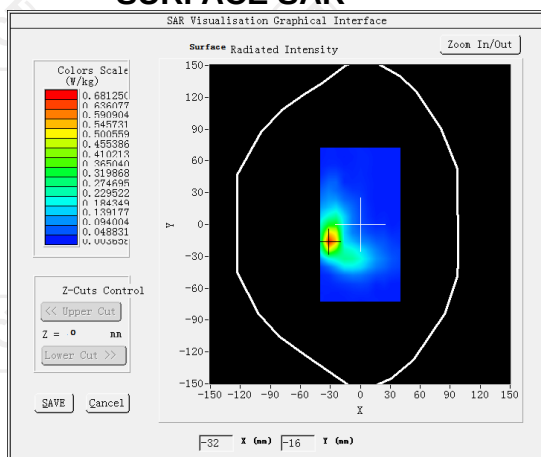
MEASUREMENT 1

High Band SAR (Channel132572):

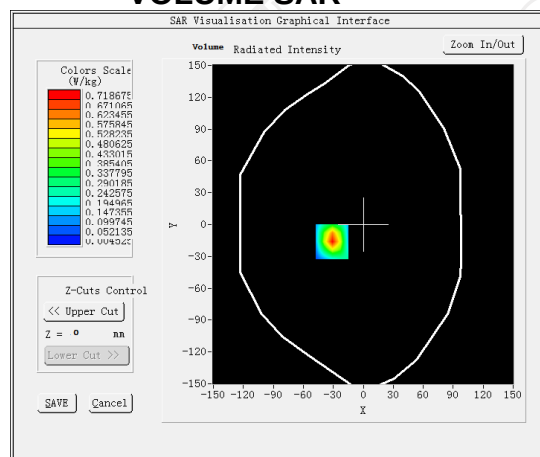
Date: 08/18/2023

Frequency (MHz)	1770.000000
Relative permittivity (real part)	40.115910
Relative permittivity (imaginary part)	14.136136
Conductivity (S/m)	1.360603
Variation (%)	-0.240000
Crest Factor	1.0
Probe Conversion factor	1.71
E-Field Probe:	SSE2 (SN 25/22 EPG0375)
Area Scan	dx=8mm dy=8mm, h= 5.00 mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete/ndx=8mm dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Body back(0mm)
Band	LTE band 66(1 RB#49)

SURFACE SAR



VOLUME SAR



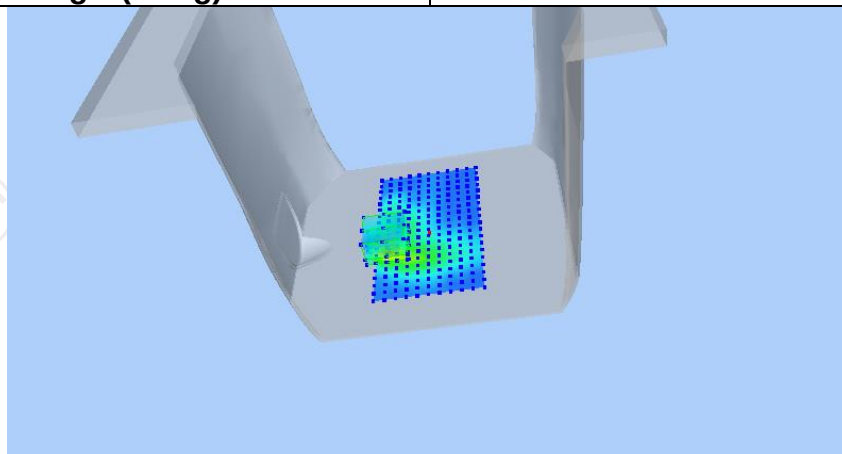
Maximum location: X=-31.00, Y=-16.00 SAR Peak: 1.41 W/kg

SAR 10g (W/Kg)

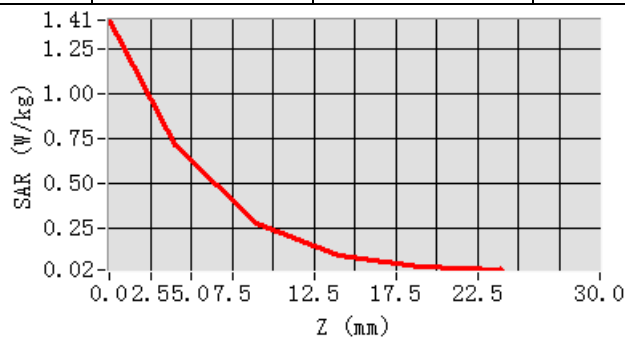
0.276988

SAR 1g (W/Kg)

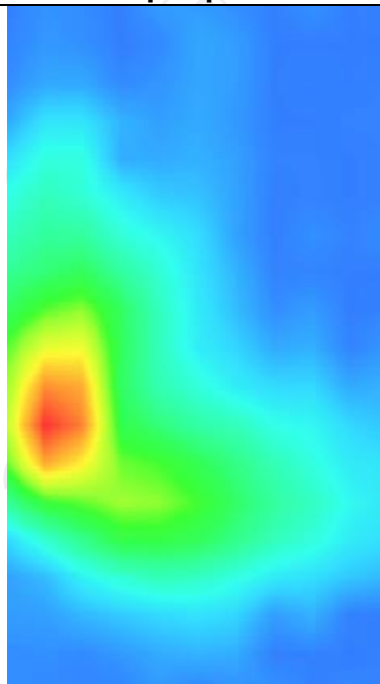
0.659672



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	1.4098	0.7187	0.2764	0.1016	0.0443



Hot spot position



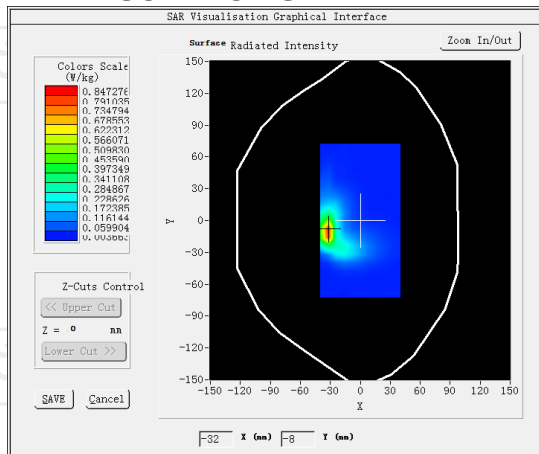
MEASUREMENT 2

High Band SAR (Channel132572):

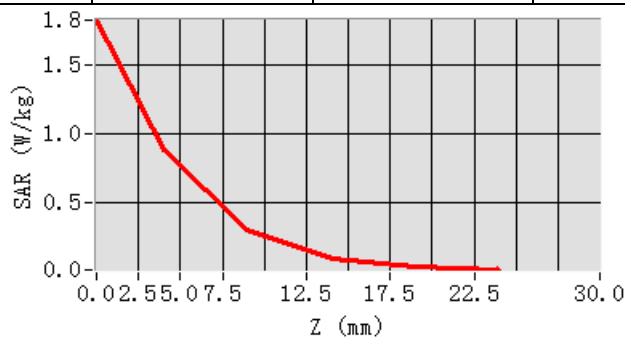
Date: 08/18/2023

Frequency (MHz)	1770.000000
Relative permittivity (real part)	40.115910
Relative permittivity (imaginary part)	14.136136
Conductivity (S/m)	1.360603
Variation (%)	-1.250000
Crest Factor	1.0
Probe Conversion factor	1.71
E-Field Probe:	SSE2 (SN 25/22 EPG0375)
Area Scan	<u>dx=8mm dy=8mm, h= 5.00 mm</u>
ZoomScan	<u>5x5x7,dx=8mm dy=8mm</u> <u>dz=5mm,Complete/ndx=8mm dy=8mm, h=</u> <u>5.00 mm</u>
Phantom	<u>Validation plane</u>
Device Position	<u>Body back(hotspot 10mm)</u>
Band	<u>LTE band 66(1 RB#49)</u>

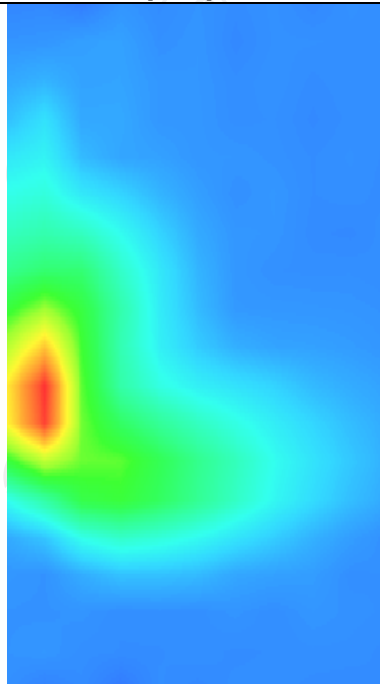
SURFACE SAR



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	1.8249	0.8888	0.3118	0.0995	0.0375



Hot spot position



LTE Band 71

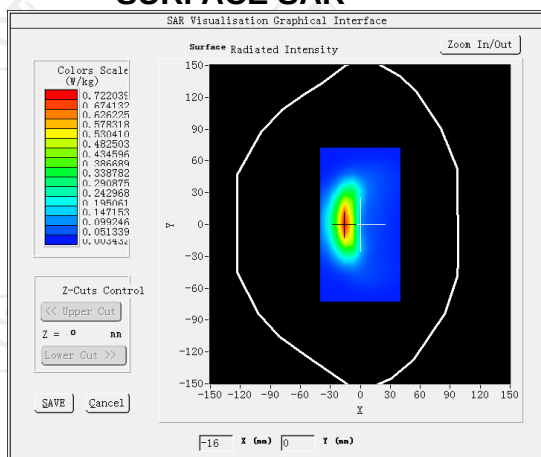
MEASUREMENT 1

Middle Band SAR (Channel 133322):

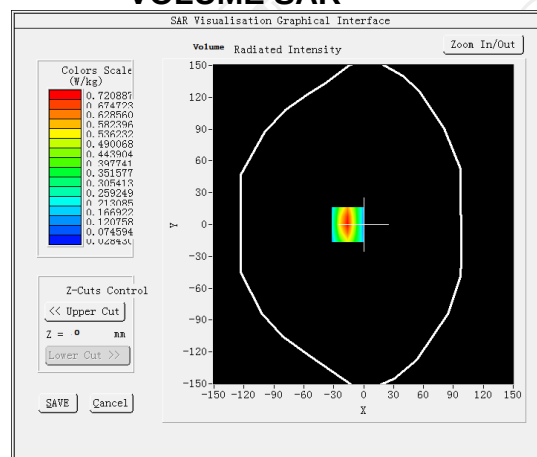
Date: 08/14/2023

Frequency (MHz)	683.000000
Relative permittivity (real part)	41.500000
Relative permittivity (imaginary part)	19.400000
Conductivity (S/m)	0.901561
Variation (%)	-4.130000
Crest Factor	1.0
Probe Conversion factor	4.36
E-Field Probe:	SSE2 (SN 25/22 EPG0375)
Area Scan	dx=8mm dy=8mm, h= 5.00 mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete/ndx=8mm dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Body back(0mm)
Band	LTE band 71(1 RB#0)

SURFACE SAR

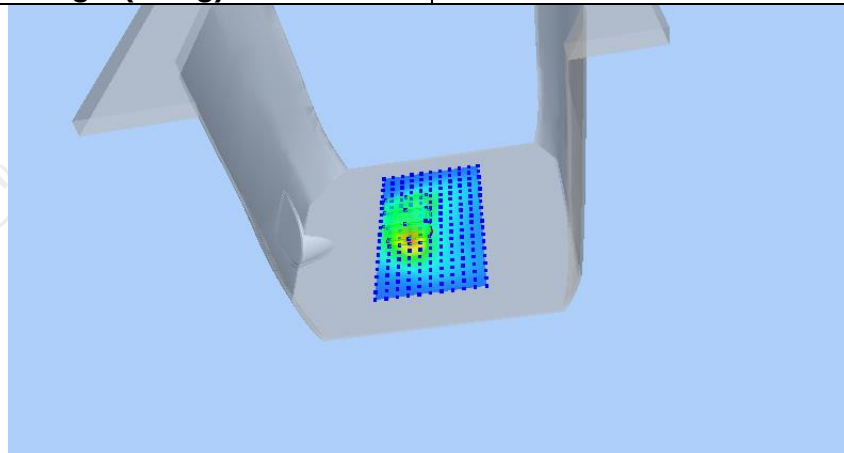


VOLUME SAR

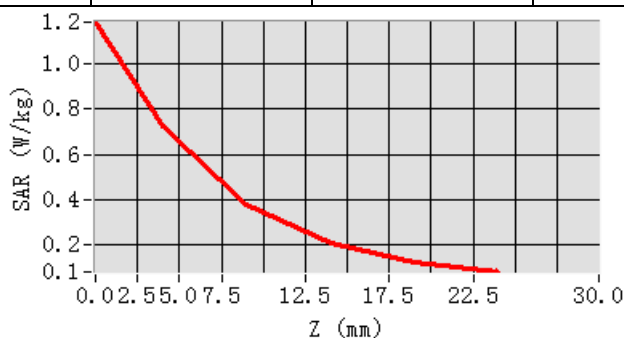


Maximum location: X=-16.00, Y=0.00 SAR Peak: 1.19 W/kg

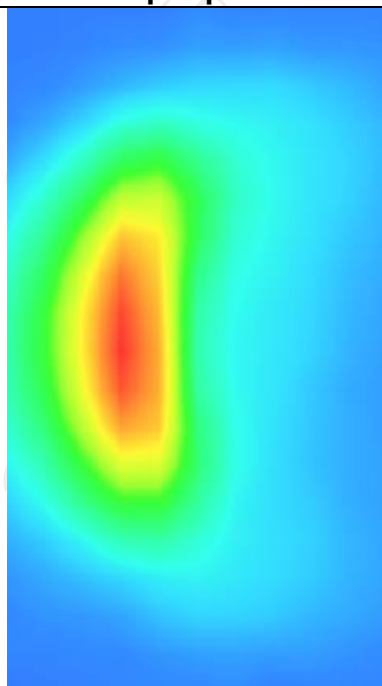
SAR 10g (W/Kg)	0.342035
SAR 1g (W/Kg)	0.367042



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	1.1828	0.7209	0.3786	0.2060	0.1256



Hot spot position



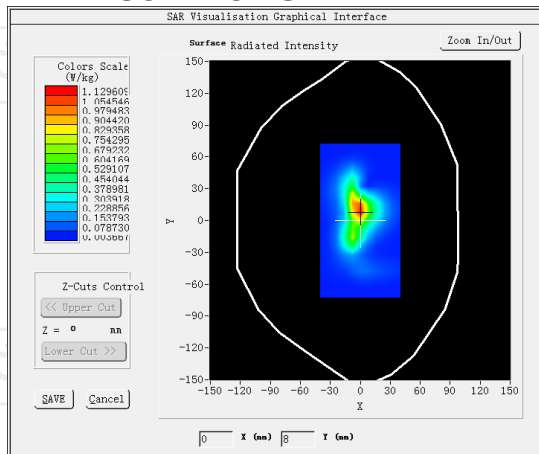
MEASUREMENT 2

Middle Band SAR (Channel 133322):

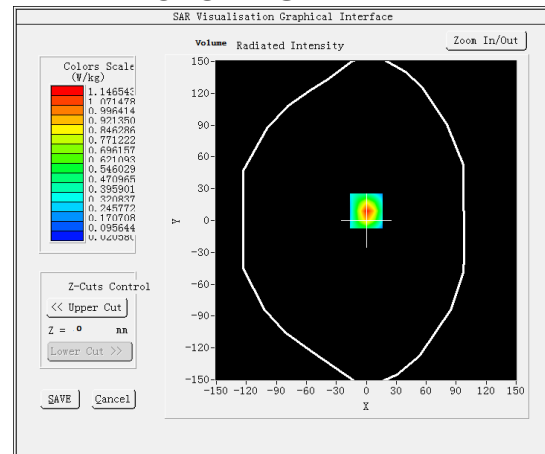
Date: 08/14/2023

Frequency (MHz)	683.000000
Relative permittivity (real part)	41.500000
Relative permittivity (imaginary part)	19.400000
Conductivity (S/m)	0.901561
Variation (%)	1.240000
Crest Factor	1.0
Probe Conversion factor	4.36
E-Field Probe:	SSE2 (SN 25/22 EPG0375)
Area Scan	<u>dx=8mm dy=8mm, h= 5.00 mm</u>
ZoomScan	<u>5x5x7, dx=8mm dy=8mm</u> <u>dz=5mm, Complete/ndx=8mm dy=8mm, h=</u> <u>5.00 mm</u>
Phantom	Validation plane
Device Position	Body back(hotspot 0mm)
Band	<u>LTE band 71(1RB#0)</u>

SURFACE SAR

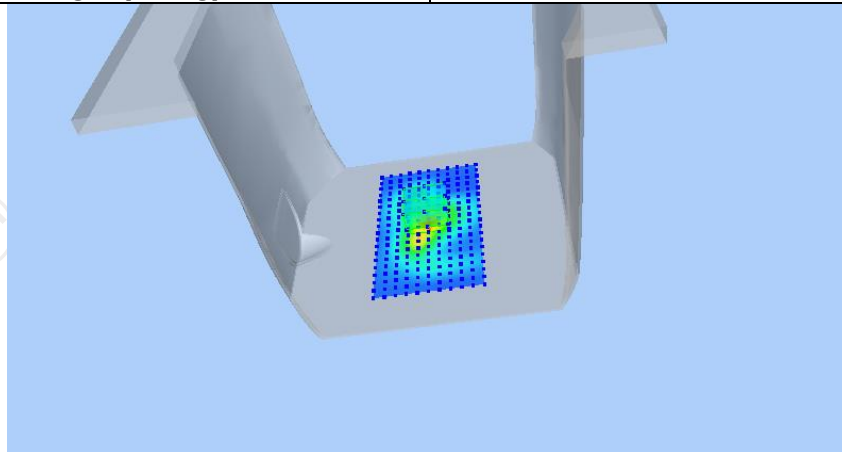


VOLUME SAR

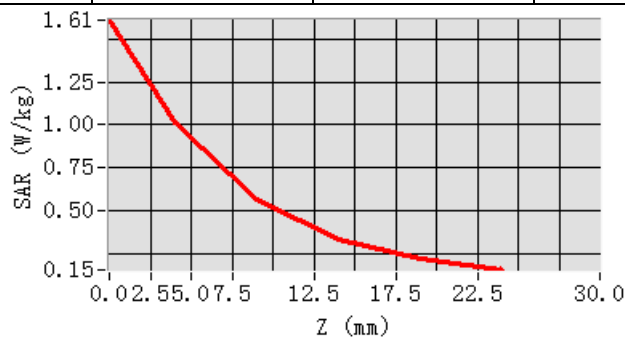


Maximum location: X=-16.00, Y=0.00 SAR Peak: 1.63 W/kg

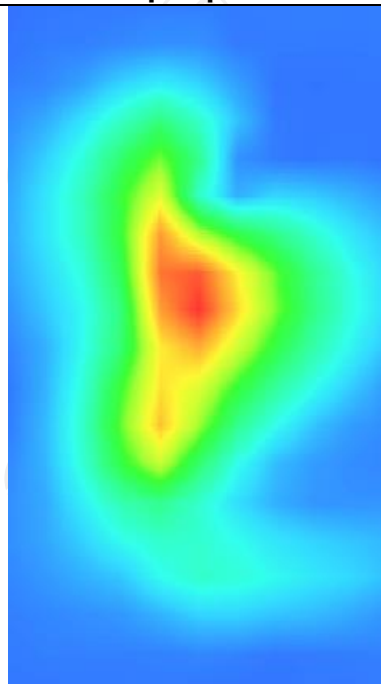
SAR 10g (W/Kg)	0.228009
SAR 1g (W/Kg)	0.367987



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	1.6115	1.0167	0.5657	0.3309	0.2175



Hot spot position

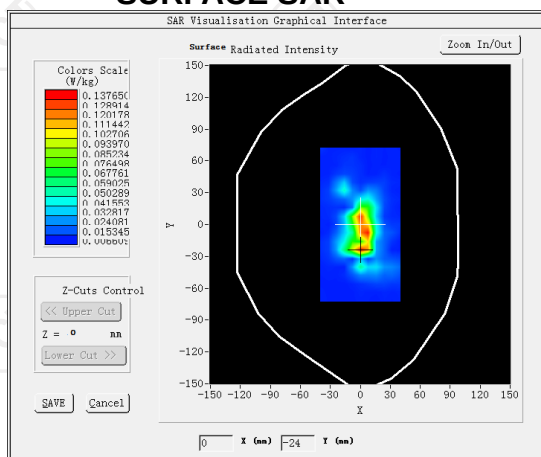


WLAN 2.4G

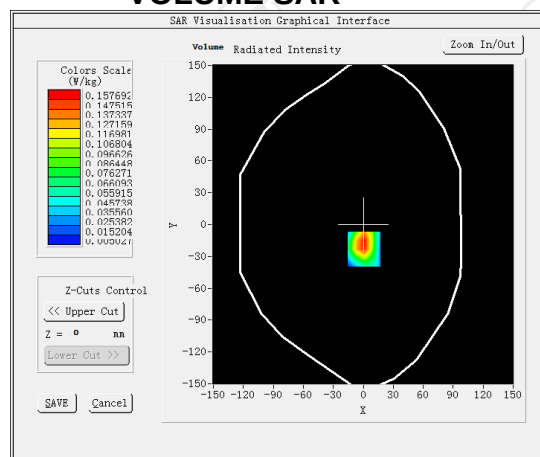
MEASUREMENT 1

Low Band SAR (Channel 1):		Date: 08/22/2023
Frequency (MHz)	2412.000000	
Relative permittivity (real part)	39.226002	
Relative permittivity (imaginary part)	13.207000	
Conductivity (S/m)	1.788081	
Variation (%)	2.610000	
Crest Factor	1.0	
Probe Conversion factor	2.31	
E-Field Probe:	SSE2 (SN 25/22 EPG0375)	
Area Scan	dx=8mm dy=8mm, h= 5.00 mm	
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete/ndx=8mm dy=8mm, h= 5.00 mm	
Phantom	Validation plane	
Device Position	Body back(0mm)	
Band	IEEE 802.11g ISM	

SURFACE SAR

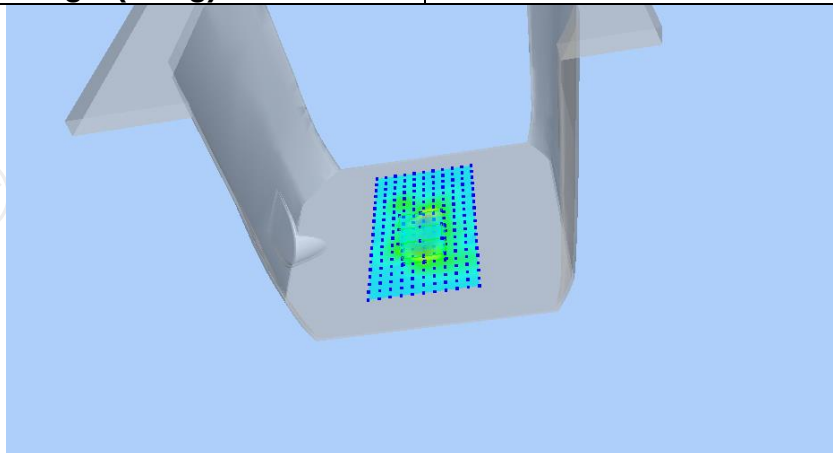


VOLUME SAR

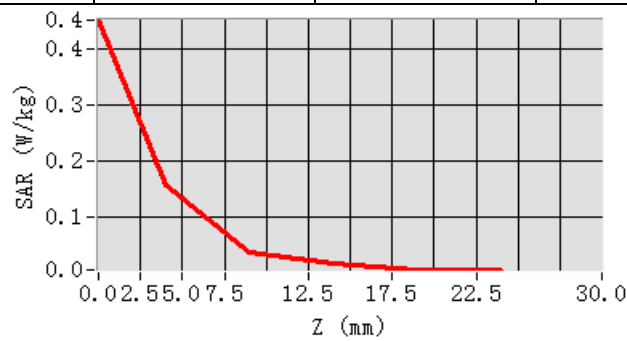


Maximum location: X=1.00, Y=23.00 SAR Peak: 0.34 W/kg

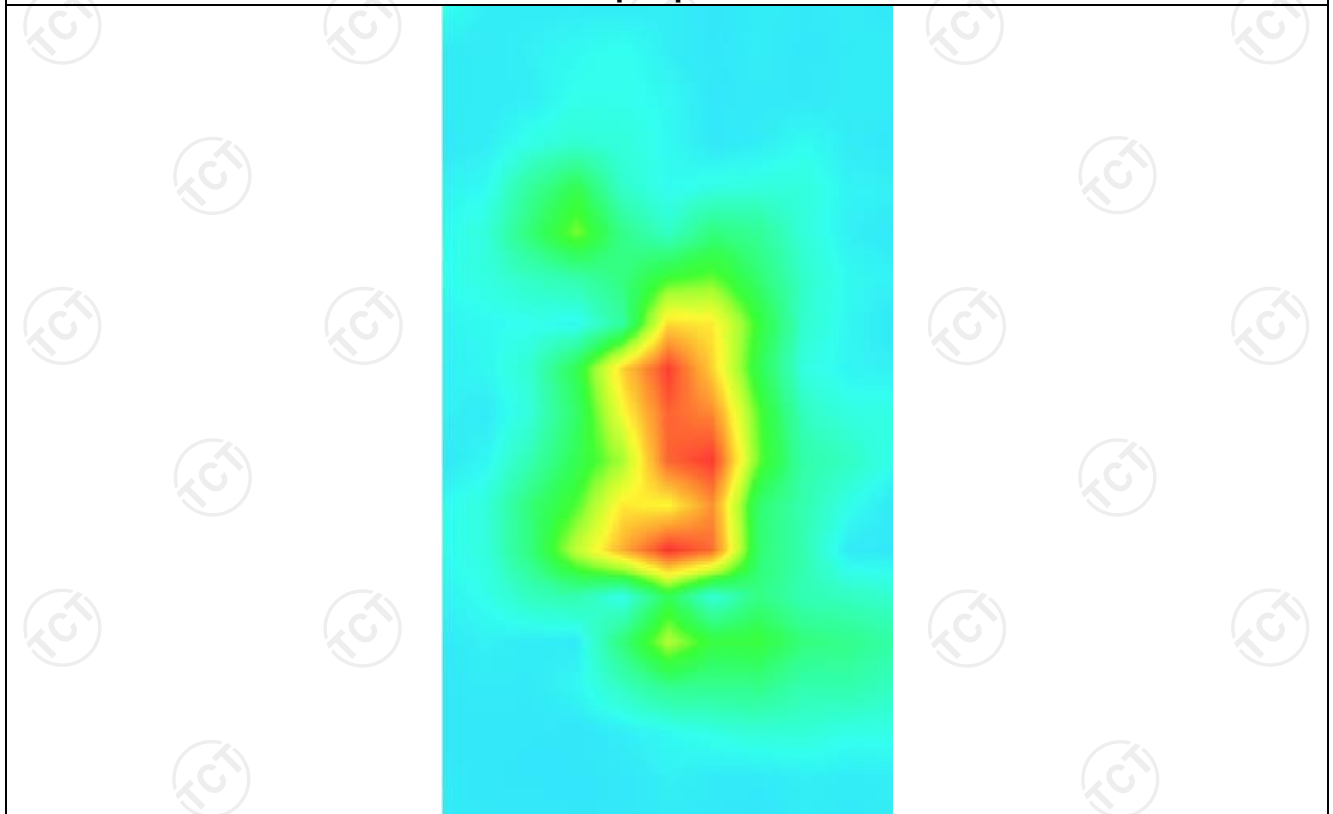
SAR 10g (W/Kg)	0.165423
SAR 1g (W/Kg)	0.233691



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.4497	0.1577	0.0368	0.0175	0.0072



Hot spot position



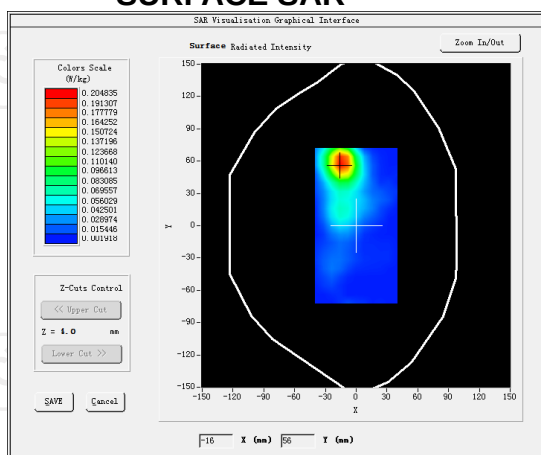
MEASUREMENT 2

Low Band SAR (Channel 1):

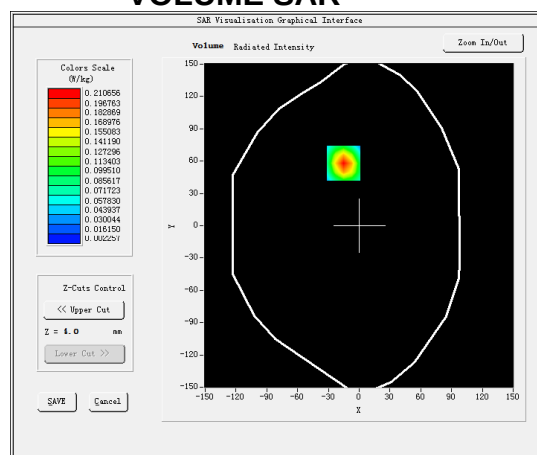
Date: 08/22/2023

Frequency (MHz)	2412.000000
Relative permittivity (real part)	39.226002
Relative permittivity (imaginary part)	13.207000
Conductivity (S/m)	1.788081
Variation (%)	3.720000
Crest Factor	1.0
Probe Conversion factor	2.31
E-Field Probe:	SSE2 (SN 25/22 EPG0375)
Area Scan	<u>dx=8mm dy=8mm, h= 5.00 mm</u>
ZoomScan	<u>5x5x7,dx=8mm dy=8mm</u> <u>dz=5mm,Complete/ndx=8mm dy=8mm, h=</u> <u>5.00 mm</u>
Phantom	Validation plane
Device Position	Body back(0mm)
Band	<u>IEEE 802.11g ISM(hotspot)</u>

SURFACE SAR

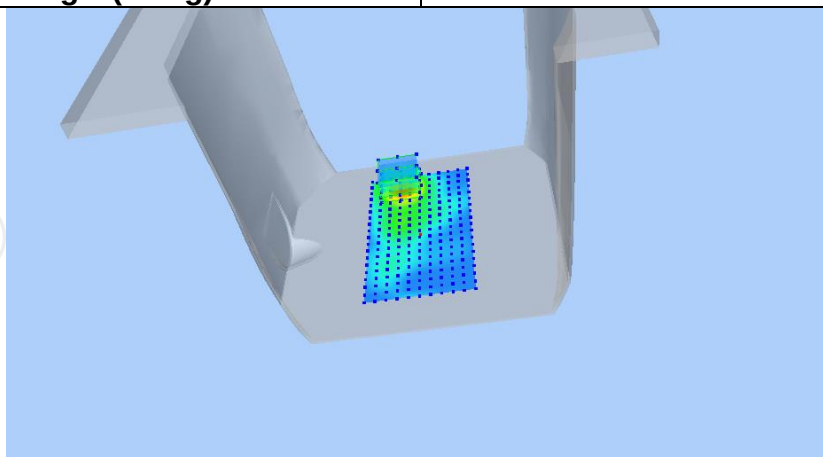


VOLUME SAR

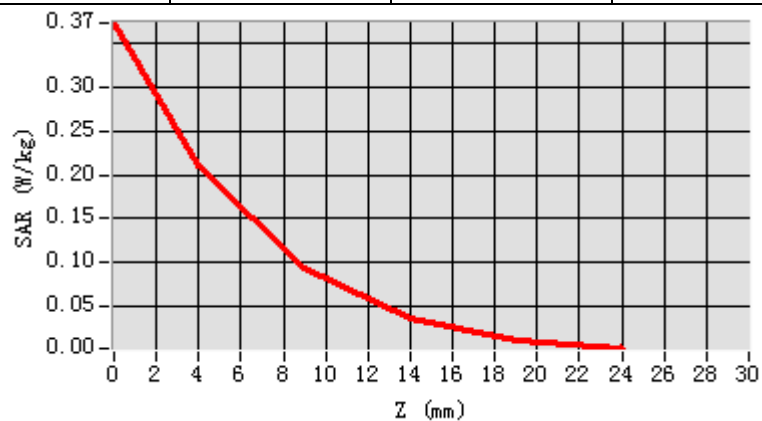


Maximum location: X=-15.00, Y=58.00 SAR Peak: 0.37 W/kg

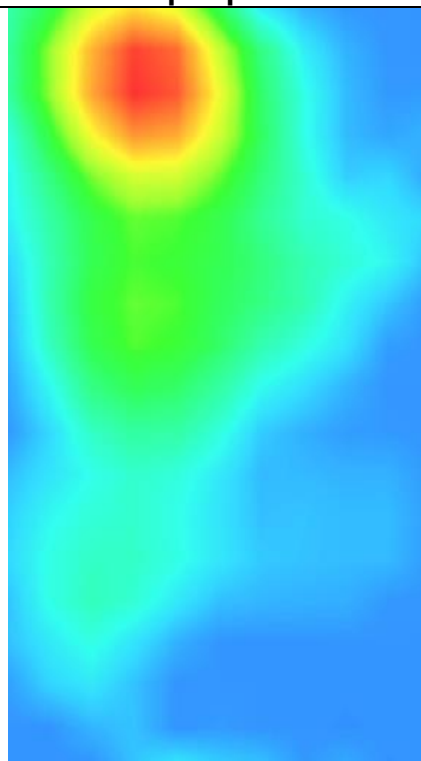
SAR 10g (W/Kg)	0.087182
SAR 1g (W/Kg)	0.263788



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.3732	0.2107	0.0935	0.0368	0.0124



Hot spot position



WLAN 5.2G

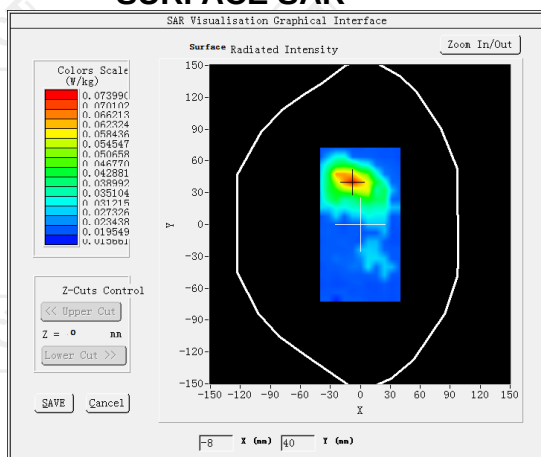
MEASUREMENT 1

SAR (Channel 36):

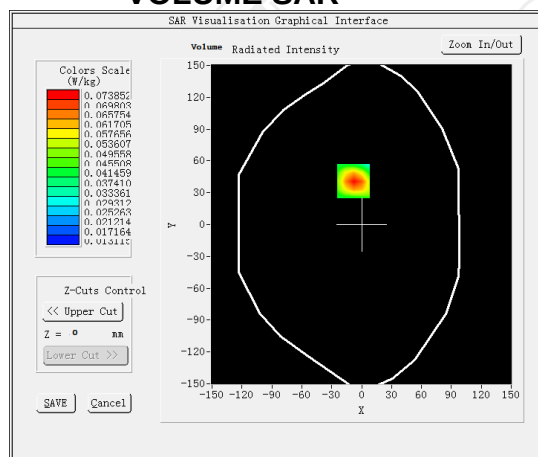
Date: 08/25/2023

Frequency (MHz)	5180.000000
Relative permittivity (real part)	35.068832
Relative permittivity (imaginary part)	13.679428
Conductivity (S/m)	5.220788
Variation (%)	-0.850000
Crest Factor	1.0
Probe Conversion factor	2.01
E-Field Probe:	SSE2 (SN 25/22 EPG0375)
Area Scan	dx=8mm dy=8mm, h= 5.00 mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete/ndx=8mm dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Body back(0mm)
Band	IEEE 802.11ac VHT20

SURFACE SAR

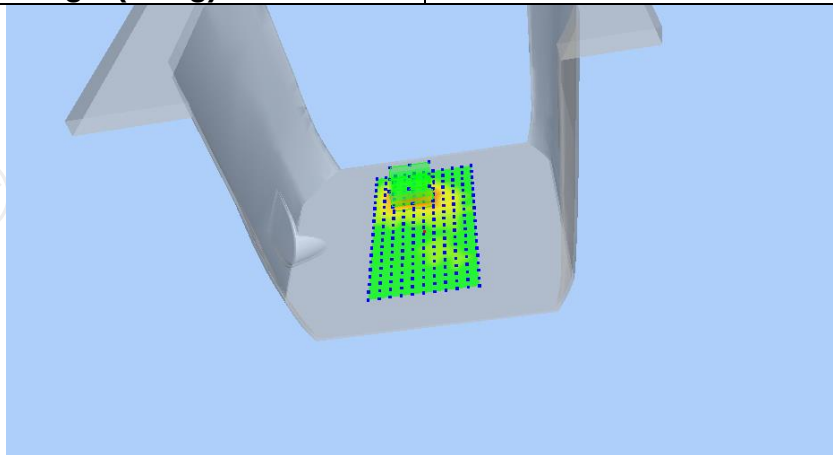


VOLUME SAR

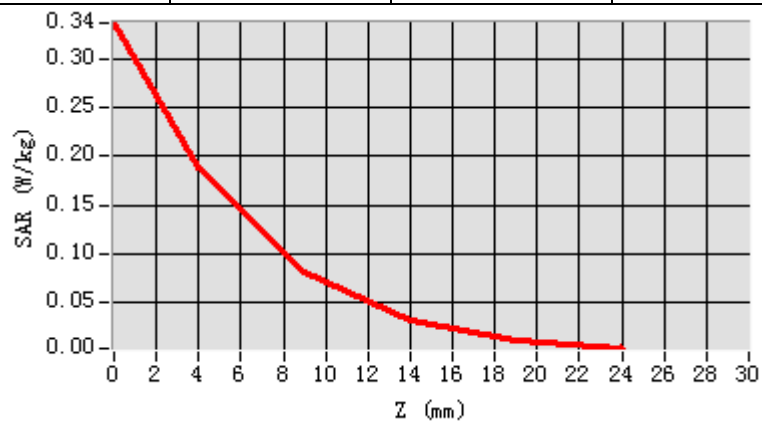


Maximum location: X=16.00, Y=63.00 SAR Peak: 0.36 W/kg

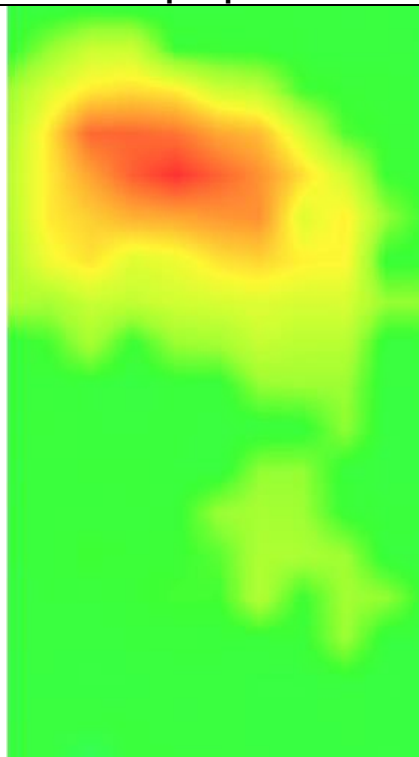
SAR 10g (W/Kg)	0.140642
SAR 1g (W/Kg)	0.198531



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.3372	0.1876	0.0816	0.0317	0.0109



Hot spot position



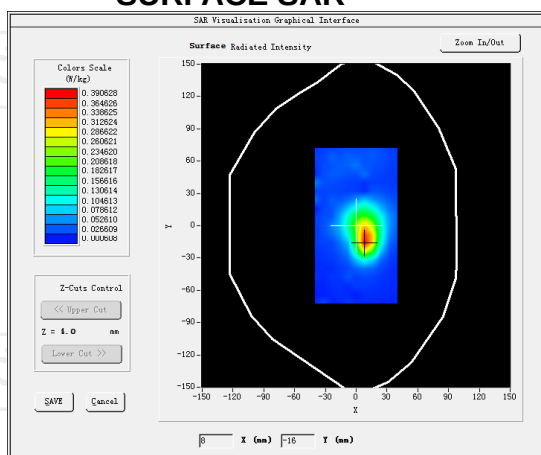
MEASUREMENT 2

SAR (Channel 36):

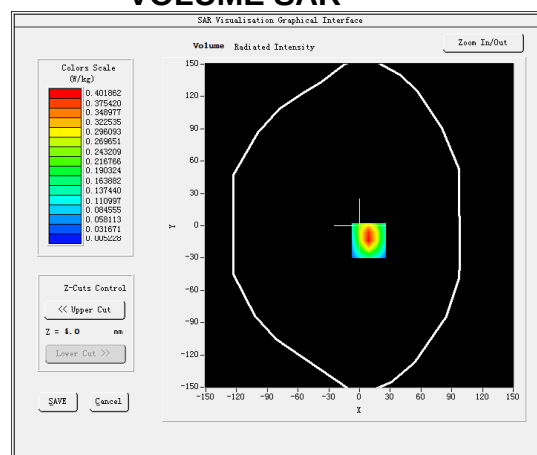
Date: 08/25/2023

Frequency (MHz)	5240.000000
Relative permittivity (real part)	35.068832
Relative permittivity (imaginary part)	13.679428
Conductivity (S/m)	5.220788
Variation (%)	3.820000
Crest Factor	1.0
Probe Conversion factor	2.01
E-Field Probe:	SSE2 (SN 25/22 EPG0375)
Area Scan	<u>dx=8mm dy=8mm, h= 5.00 mm</u>
ZoomScan	<u>5x5x7, dx=8mm dy=8mm</u> <u>dz=5mm, Complete/ndx=8mm dy=8mm, h=</u> <u>5.00 mm</u>
Phantom	Validation plane
Device Position	Body back(hotspot 0mm)
Band	IEEE 802.11ac VHT20

SURFACE SAR

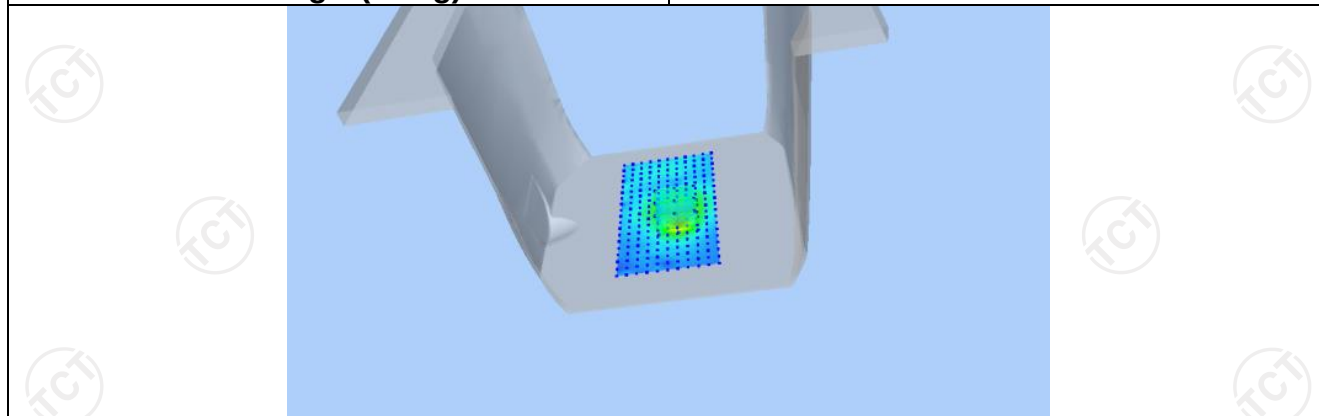


VOLUME SAR

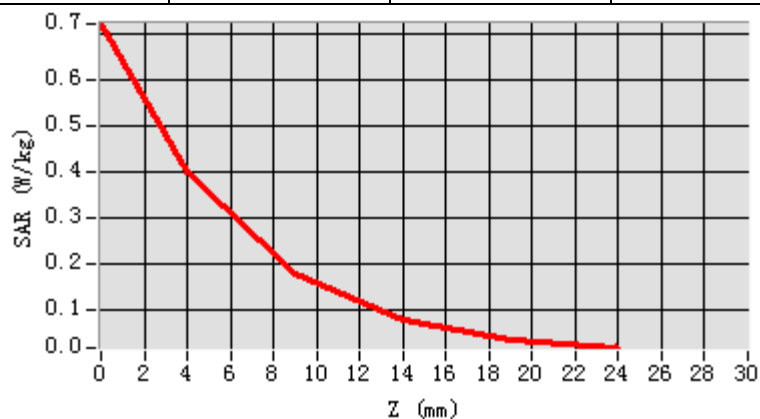


Maximum location: X=19.00, Y=-12.00 SAR Peak: 0.70 W/kg

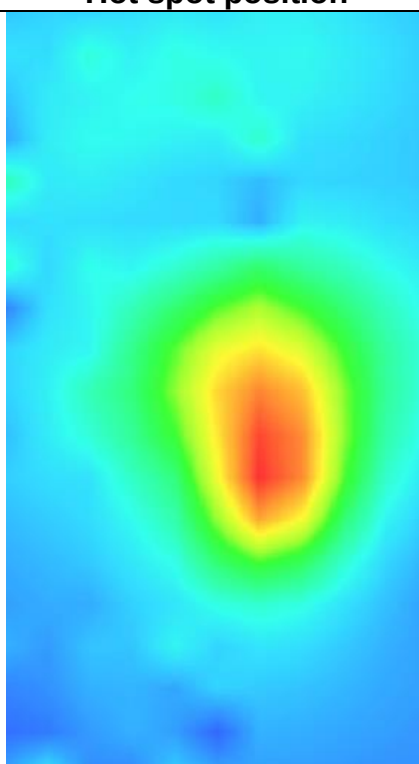
SAR 10g (W/Kg)	0.174213
SAR 1g (W/Kg)	0.241152



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.7042	0.4012	0.1842	0.0710	0.0314



Hot spot position



WLAN 5.8G

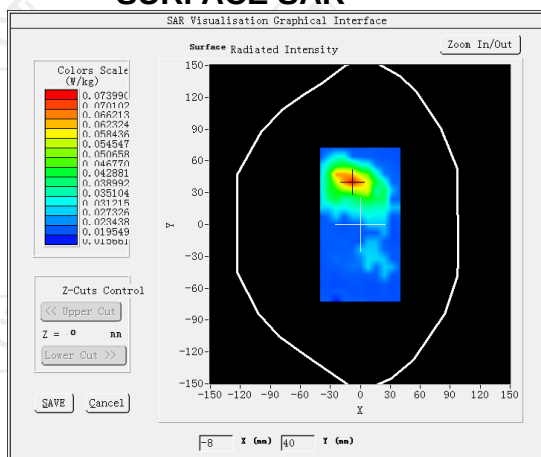
MEASUREMENT 1

SAR (Channel 151):

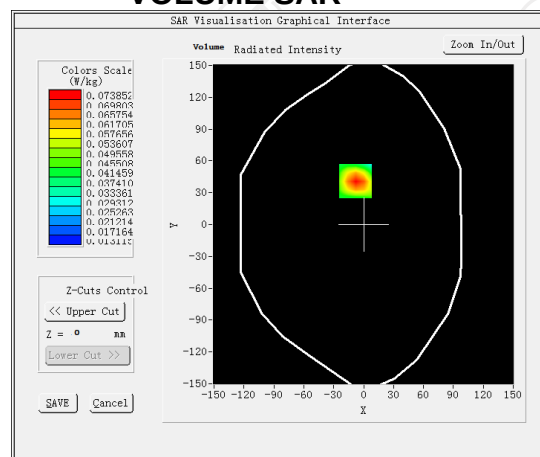
Date: 08/28/2023

Frequency (MHz)	5755.000000
Relative permittivity (real part)	38.352823
Relative permittivity (imaginary part)	13.671675
Conductivity (S/m)	5.430828
Variation (%)	-2.950000
Crest Factor	1.0
Probe Conversion factor	2.13
E-Field Probe:	SSE2 (SN 25/22 EPG0375)
Area Scan	dx=8mm dy=8mm, h= 5.00 mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete/ndx=8mm dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Body back(0mm)
Band	IEEE 802.11n VHT40

SURFACE SAR

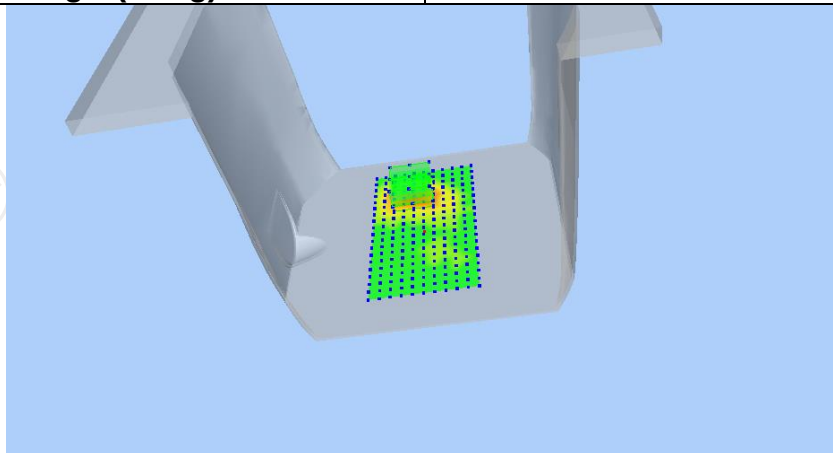


VOLUME SAR

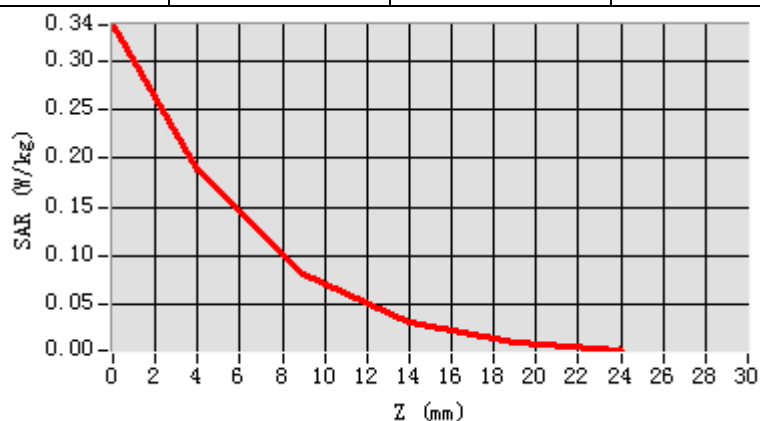


Maximum location: X=15.00, Y=60.00 SAR Peak: 0.34 W/kg

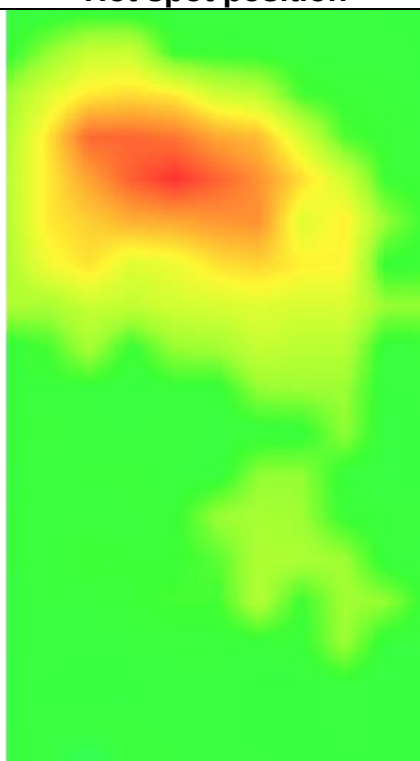
SAR 10g (W/Kg)	0.151431
SAR 1g (W/Kg)	0.255420



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.3397	0.1890	0.0823	0.0317	0.0117



Hot spot position



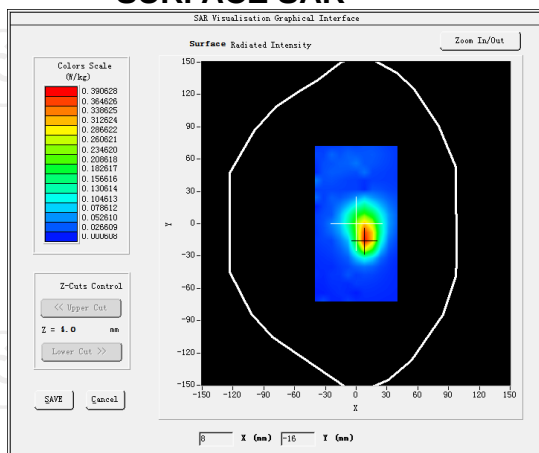
MEASUREMENT 2

SAR (Channel 155):

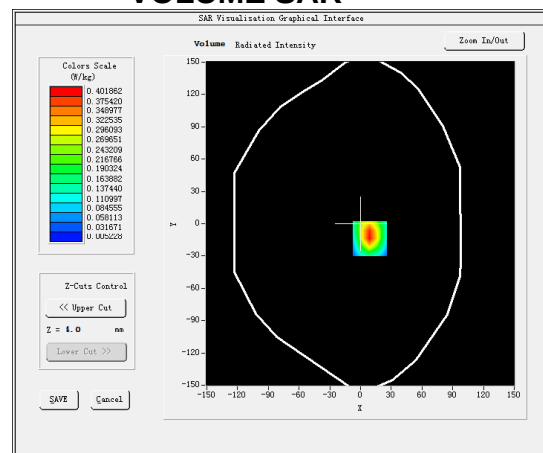
Date: 08/25/2023

Frequency (MHz)	5755.000000
Relative permittivity (real part)	38.352823
Relative permittivity (imaginary part)	13.671675
Conductivity (S/m)	5.430828
Variation (%)	-1.450000
Crest Factor	1.0
Probe Conversion factor	2.13
E-Field Probe:	SSE2 (SN 25/22 EPGO375)
Area Scan	<u>dx=8mm dy=8mm, h= 5.00 mm</u>
ZoomScan	<u>5x5x7,dx=8mm dy=8mm</u> <u>dz=5mm,Complete/ndx=8mm dy=8mm, h=</u> <u>5.00 mm</u>
Phantom	<u>Validation plane</u>
Device Position	<u>Body back(0mm)</u>
Band	IEEE 802.11n HT40(hotspot)

SURFACE SAR

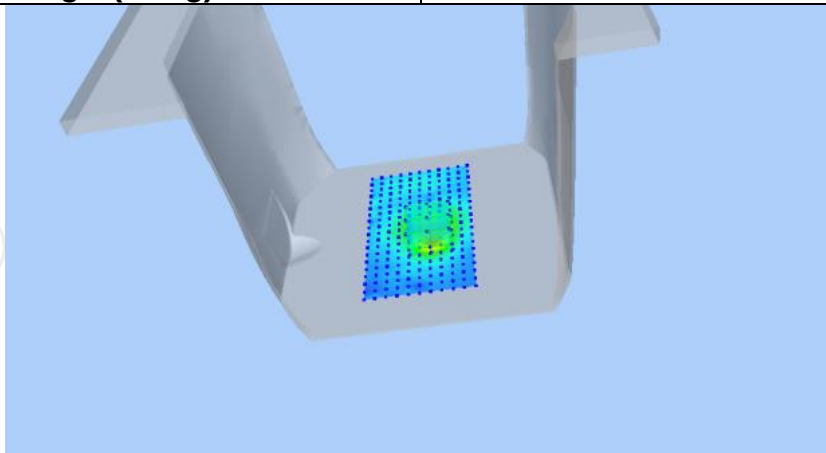


VOLUME SAR

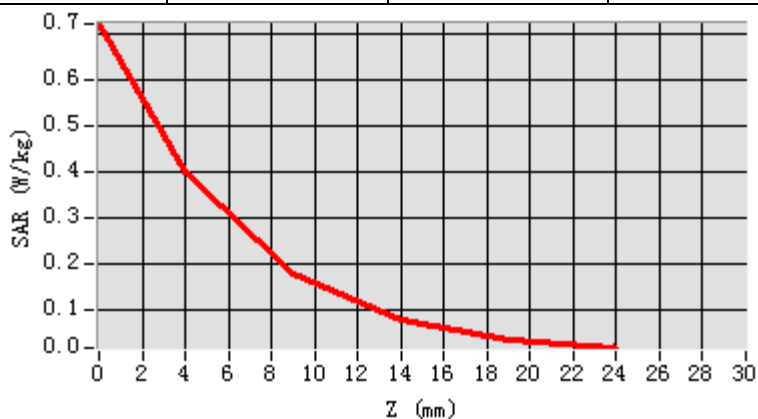


Maximum location: X=19.00, Y=-12.00 SAR Peak: 0.70 W/kg

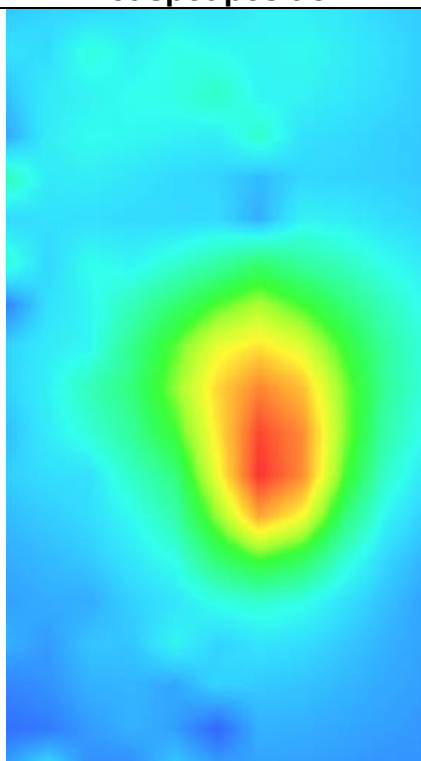
SAR 10g (W/Kg)	0.163397
SAR 1g (W/Kg)	0.282473



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.7032	0.4014	0.1808	0.0734	0.0402



Hot spot position



BT

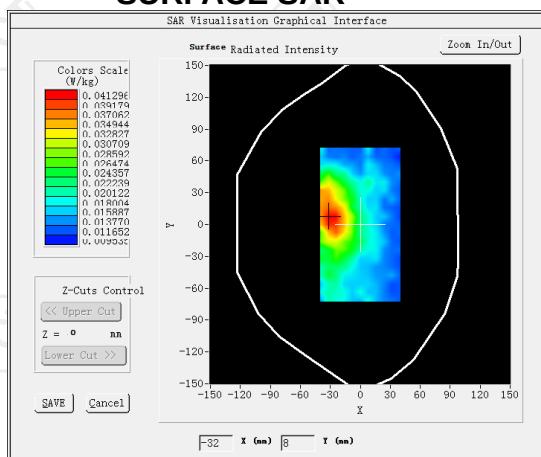
MEASUREMENT 1

Middle Band SAR (Channel 39):

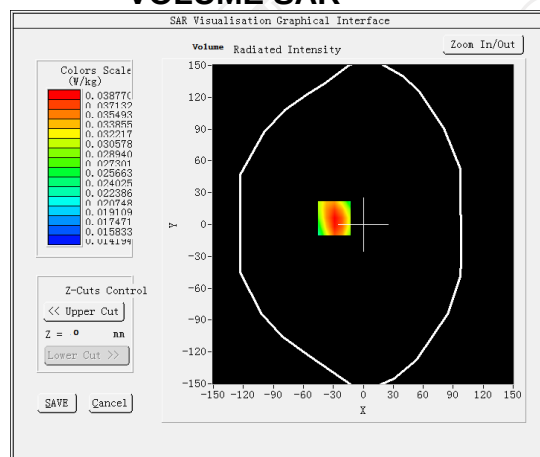
Date: 08/22/2023

Frequency (MHz)	2441.000000
Relative permittivity (real part)	39.217999
Relative permittivity (imaginary part)	13.211000
Conductivity (S/m)	1.791558
Variation (%)	-1.610000
Crest Factor	1.0
Probe Conversion factor	2.31
E-Field Probe:	SSE2 (SN 25/22 EPG0375)
Area Scan	dx=8mm dy=8mm, h= 5.00 mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete/ndx=8mm dy=8mm, h= 5.00 mm
Phantom	Validation plane
Device Position	Body back(0mm)
Band	Pi/4DQPSK

SURFACE SAR



VOLUME SAR



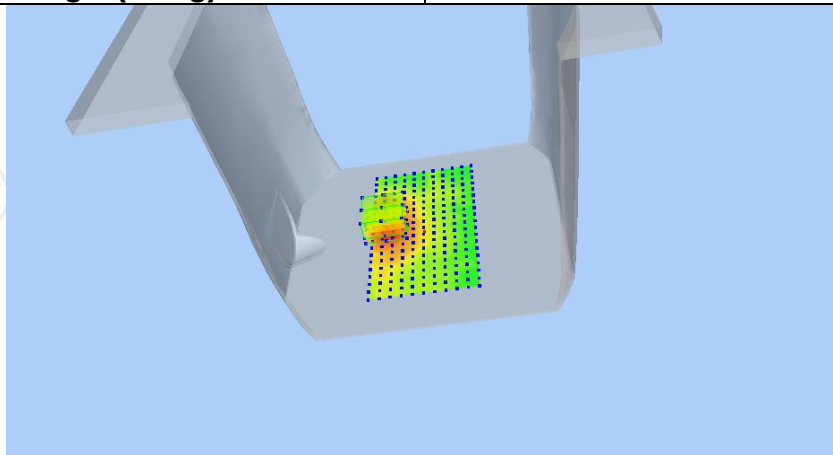
Maximum location: X=-29.00, Y=6.00 SAR Peak: 0.05 W/kg

SAR 10g (W/Kg)

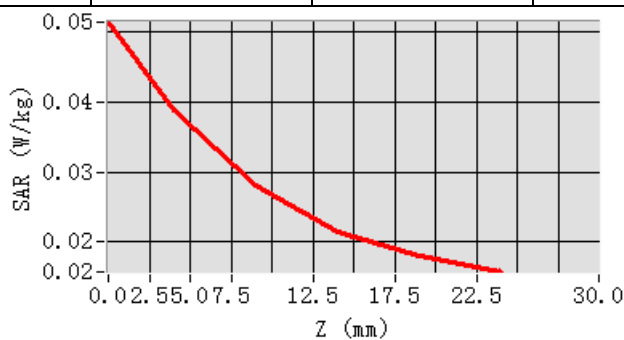
0.028107

SAR 1g (W/Kg)

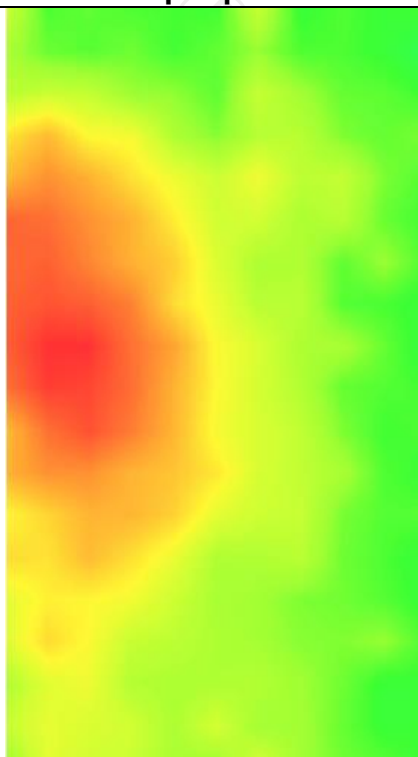
0.067717



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.0515	0.0388	0.0280	0.0215	0.0180



Hot spot position



Appendix A: EUT Photos



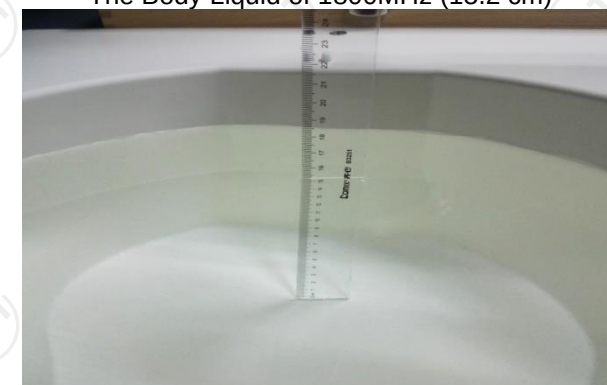
Liquid depth



The Body Liquid of 835MHz (15.4cm)



The Body Liquid of 1800MHz (15.2 cm)



The Body Liquid of 1900MHz (16.4 cm)



The Body Liquid of 2450MHz (15.3cm)



The Body Liquid of 5000-6000MHz (16.5cm)



The Body Liquid of 750MHz (15.4cm)



The Body Liquid of 2600MHz (16.5cm)



Appendix B: Test Setup Photos



Body worn – Front (0mm)



Body worn – Back (0mm)



Hotspo Back (0mm)



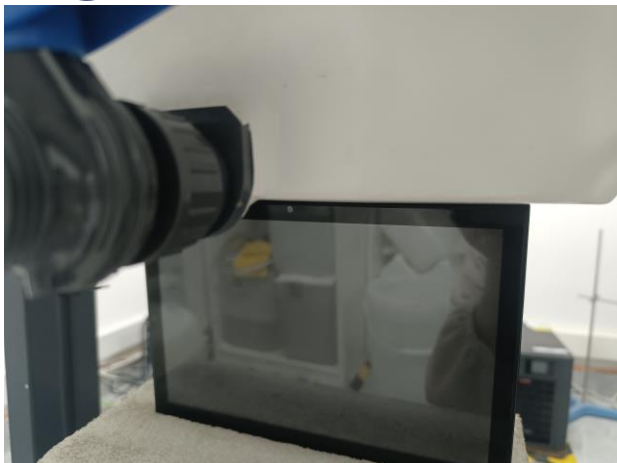
Hotspo Front (0mm)



Hotspot Left (0mm)



Hotspot Right (0mm)



Hotspot Top (0mm)

Appendix C: Probe Calibration Certificate

COMOSAR E-FIELD Probe



COMOSAR E-Field Probe Calibration Report

Ref : ACR.180.7.22.BES.B

SHENZHEN TONGCE TESTING LAB

2101 & 2201, ZHENCHANG FACTORY RENSHAN INDUSTRIAL
ZONE, FUHAI SUBDISTRICT, BAO'AN DISTRICT SHENZHEN,
GUANGDONG, 518103, PEOPLE'S REPUBLIC OF CHINA
MVG COMOSAR DOSIMETRIC E-FIELD PROBE

SERIAL NO.: SN 25/22 EPG0375

Calibrated at MVG

Z.I. de la pointe du diable

Technopôle Brest Iroise – 295 avenue Alexis de Rochon
29280 PLOUZANE - FRANCE

Calibration date: 06/29/2023



Accreditations #2-6789
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.180.7.22.BES.B

	<i>Name</i>	<i>Function</i>	<i>Date</i>	<i>Signature</i>
<i>Prepared by :</i>	Jérôme Le Gall	Measurement Responsible	6/30/2023	
<i>Checked & approved by:</i>	Jérôme Luc	Technical Manager	6/30/2023	
<i>Authorized by:</i>	Yann Toutain	Laboratory Director	7/05/2023	

	<i>Customer Name</i>
<i>Distribution :</i>	Shenzhen Tongce Testing Lab

<i>Issue</i>	<i>Name</i>	<i>Date</i>	<i>Modifications</i>
A	Jérôme Le Gall	6/30/2023	Initial release

Page: 2/11

Template_ACR.DDD.N.YY.MVGB.ISSUE_COMOSAR Probe vK

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COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.180.7.22.BES.B

TABLE OF CONTENTS

1	Device Under Test	4
2	Product Description	4
2.1	General Information	4
3	Measurement Method	4
3.1	Linearity	4
3.2	Sensitivity	4
3.3	Lower Detection Limit	5
3.4	Isotropy	5
3.1	Boundary Effect	5
4	Measurement Uncertainty	6
5	Calibration Measurement Results	6
5.1	Sensitivity in air	6
5.2	Linearity	7
5.3	Sensitivity in liquid	8
5.4	Isotropy	9
6	List of Equipment	10

Page: 3/11

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Page 145 of 242

**COMOSAR E-FIELD PROBE CALIBRATION REPORT**

Ref: ACR.180.7.22.BES.B

1 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR DOSIMETRIC E FIELD PROBE
Manufacturer	MVG
Model	SSE2
Serial Number	SN 25/22 EPGO375
Product Condition (new / used)	New
Frequency Range of Probe	0.15 GHz-6GHz
Resistance of Three Dipoles at Connector	Dipole 1: R1=0.197 MΩ Dipole 2: R2=0.230 MΩ Dipole 3: R3=0.208 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.

Page: 4/11

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Page 146 of 242



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:

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

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%).



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 ($\mu\text{V}/(\text{V}/\text{m})^2$)	Normy dipole 2 ($\mu\text{V}/(\text{V}/\text{m})^2$)	Normz dipole 3 ($\mu\text{V}/(\text{V}/\text{m})^2$)
0.64	0.53	0.44

DCP dipole 1 (mV)	DCP dipole 2 (mV)	DCP dipole 3 (mV)
106	108	109

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

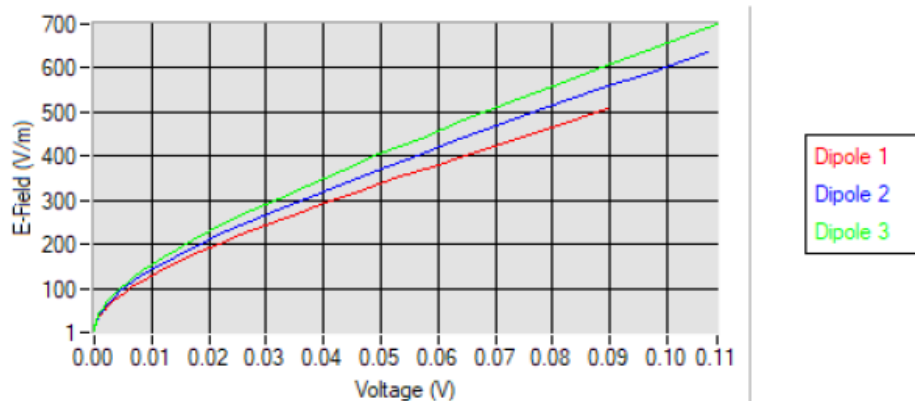
$$E = \sqrt{E_1^2 + E_2^2 + E_3^2}$$



COMOSAR E-FIELD PROBE CALIBRATION REPORT

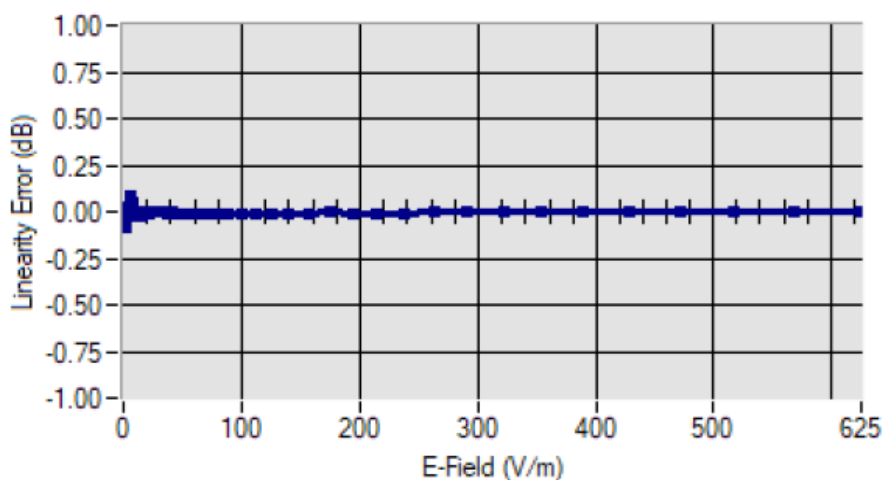
Ref: ACR.180.7.22.BES.B

Calibration curves



5.2 LINEARITY

Linearity



Linearity: +/- 1.94% (+/- 0.09dB)



COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.180.7.22.BES.B

5.3 SENSITIVITY IN LIQUID

<u>Liquid</u>	<u>Frequency</u> <u>(MHz +/-</u> <u>100MHz)</u>	<u>ConvF</u>
HL750	750	1.71
BL750	750	1.78
HL900	900	1.91
BL900	900	1.96
HL1800	1800	2.08
BL1800	1800	2.16
HL2000	2000	2.03
BL2000	2000	2.10
HL2450	2450	2.31
BL2450	2450	2.37
HL2600	2600	2.16
BL2600	2600	2.23
HL3500	3500	2.21
BL3500	3500	2.28
HL3700	3700	3.45
BL3700	3700	3.15
HL4600	4600	3.30
BL4600	4600	3.70
HL5200	5200	2.01
BL5200	5200	2.08
HL5600	5600	2.07
BL5600	5600	2.12
HL5800	5800	2.06
BL5800	5800	2.13

LOWER DETECTION LIMIT: 7mW/kg

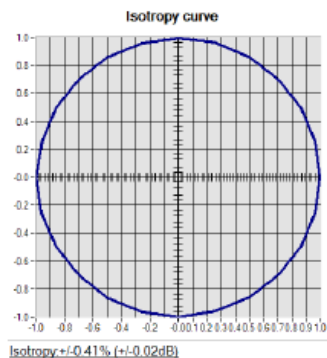


COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.180.7.22.BES.B

5.4 ISOTROPY

HL1800 MHz





COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref. ACR.180.7.22.BES.B

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	10/2023	10/2026
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	11/2023	11/2026
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.

Page: 10/11

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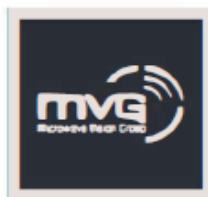
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COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.180.7.22.BES.B

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



Dielectric Probe Calibration Report

Ref : ACR.138.4.33.SATU.A

SHENZHEN TONGCE TESTING LAB
2101&2201, ZHENCHANG FACTORY, RENSHAN
INDUSTRIAL ZONE, FUHAI SUBDISTRICT, BAOAN
DISTRICT, SHENZHEN, GUANGDONG, 518103,
PEOPLES REPUBLIC OF CHINA
MVG COMOSAR DOSIMETRIC E-FIELD PROBE

FREQUENCY: 0.3-6 GHZ
SERIAL NO.: SN 19/15 OCPG 71

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



Calibration Date: 06/05/2021

Summary:

This document presents the method and results from an accredited Dielectric Probe calibration performed in MVG USA using the LIMESAR test bench. All calibration results are traceable to national metrology institutions.



SAR DIELECTRIC PROBE CALIBRATION REPORT

Ref: ACR.138.4.33..SATUA

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	06/05/2021	<i>JS</i>
Checked by :	Jérôme LUC	Product Manager	06/05/2021	<i>JS</i>
Approved by :	Kim RUTKOWSKI	Quality Manager	06/05/2021	<i>Kim Rutkowski</i>

	Customer Name
Distribution :	SHENZHEN TONGCE TESTING LAB

Issue	Date	Modifications
A	06/05/2021	Initial release

Page: 2/7

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Page 155 of 242



SAR DIELECTRIC PROBE CALIBRATION REPORT

Ref: ACR.138.4.33..SATU.A

TABLE OF CONTENTS

1	Introduction.....	4
2	Device Under Test	4
3	Product Description	4
3.1	General Information	4
4	Measurement Method	5
4.1	Liquid Permittivity Measurements	5
5	Measurement Uncertainty	5
5.1	Dielectric Permittivity Measurement	5
6	Calibration Measurement Results	6
6.1	Liquid Permittivity Measurement	6
7	List of Equipment	7

Page: 3/7

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SAR DIELECTRIC PROBE CALIBRATION REPORT

Ref: ACR.138.4.33..SATU.A

1 INTRODUCTION

This document contains a summary of the suggested methods and requirements set forth by the IEEE 1528 and CEI/IEC 62209 standards for liquid permittivity measurements 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	LIMESAR DIELECTRIC PROBE
Manufacturer	MVG
Model	SCLMP
Serial Number	SN 19/15 OCPG 71
Product Condition (new / used)	Used

A yearly calibration interval is recommended.

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

MVG's Dielectric Probes are built in accordance to the IEEE 1528 and CEI/IEC 62209 standards. The product is designed for use with the LIMESAR test bench only.



Figure 1 – MVG LIMESAR Dielectric Probe

Page: 4/7

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4 MEASUREMENT METHOD

The IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209-1 & 2 standards outline techniques for dielectric property measurements. The LIMESAR test bench employs one of the methods outlined in the standards, using a contact probe or open-ended coaxial transmission-line probe and vector network analyzer. The standards recommend the measurement of two reference materials that have well established and stable dielectric properties to validate the system, one for the calibration and one for checking the calibration. The LIMESAR test bench uses De-ionized water as the reference for the calibration and either DMS or Methanol as the reference for checking the calibration. The following measurements were performed to verify that the product complies with the fore mentioned standards.

4.1 LIQUID PERMITTIVITY MEASUREMENTS

The permittivity of a liquid with well established dielectric properties was measured and the measurement results compared to the values provided in the fore mentioned standards.

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 DIELECTRIC PERMITTIVITY MEASUREMENT

The following uncertainties apply to the Dielectric Permittivity measurement:

Uncertainty analysis of Permittivity Measurement					
ERROR SOURCES	Uncertainty value (+/- %)	Probability Distribution	Divisor	ci	Standard Uncertainty (+/- %)
Repeatability (n repeats, mid-band)	4.00%	N	1	1	4.000%
Deviation from reference liquid	5.00%	R	$\sqrt{3}$	1	2.887%
Network analyser-drift, linearity	2.00%	R	$\sqrt{3}$	1	1.155%
Test-port cable variations	0.00%	U	$\sqrt{2}$	1	0.000%
Combined standard uncertainty					5.066%
Expanded uncertainty (confidence level of 95%, k = 2)					10.0%

Uncertainty analysis of Conductivity Measurement					
ERROR SOURCES	Uncertainty value (+/- %)	Probability Distribution	Divisor	ci	Standard Uncertainty (+/- %)
Repeatability (n repeats, mid-band)	3.50%	N	1	1	3.500%
Deviation from reference liquid	3.00%	R	$\sqrt{3}$	1	1.732%
Network analyser-drift, linearity	2.00%	R	$\sqrt{3}$	1	1.155%
Test-port cable variations	0.00%	U	$\sqrt{2}$	1	0.000%
Combined standard uncertainty					4.072%
Expanded uncertainty (confidence level of 95%, k = 2)					8.1%

Page: 5/7

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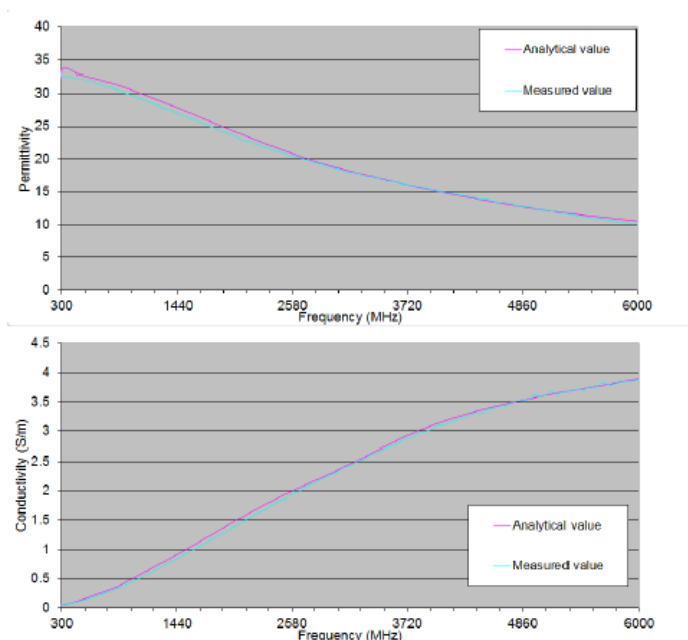
6 CALIBRATION MEASUREMENT RESULTS

Measurement Condition

Software	LIMESAR
Liquid Temperature	21°C
Lab Temperature	21°C
Lab Humidity	44%

6.1 LIQUID PERMITTIVITY MEASUREMENT

A liquid of known characteristics (methanol at 20°C) is measured with the probe and the results (complex permittivity $\epsilon' + j\epsilon''$) are compared with the well-known theoretical values for this liquid.



Page: 6/7

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SAR DIELECTRIC PROBE CALIBRATION REPORT

Ref: ACR138.4.33..SATU.A

7 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	Manufacturer / Model	Identification No.	Current Calibration Date	Next Calibration Date
LIMESAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rhode & Schwarz ZVA	SN100132	02/2021	02/2024
Methanol CAS 67-56-1	Alpha Aesar	Lot D13W011	Validated. No cal required.	Validated. No cal required.
Temperature and Humidity Sensor	Control Company	11-661-9	09/2022	09/2023

Page: 7/7

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Appendix D: Dipole Calibration Report

SID750



SAR Reference Dipole Calibration Report

Ref : ACR.156.3.15.SATU.A

SHENZHEN TONGCE TESTING LAB

2101&2201, ZHENCHANG FACTORY, RENSHAN
INDUSTRIAL ZONE, FUHAI SUBDISTRICT, BAOAN
DISTRICT, SHENZHEN, GUANGDONG, 518103,
PEOPLES REPUBLIC OF CHINA

COMOSAR REFERENCE DIPOLE

FREQUENCY: 750 MHZ

SERIAL NO.: SN 16/15 DIP 0G750-368

Calibrated at MVG US

2105 Barrett Park Dr. - Kennesaw, GA 30144



Calibration Date: 06/05/2021

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.156.3.15.SATUA

	<i>Name</i>	<i>Function</i>	<i>Date</i>	<i>Signature</i>
<i>Prepared by :</i>	Jérôme LUC	Product Manager	06/05/2021	
<i>Checked by :</i>	Jérôme LUC	Product Manager	06/05/2021	
<i>Approved by :</i>	Kim RUTKOWSKI	Quality Manager	06/05/2021	

	<i>Customer Name</i>
<i>Distribution :</i>	SHENZHEN TONGCE TESTING LAB

<i>Issue</i>	<i>Date</i>	<i>Modifications</i>
A	06/05/2021	Initial release

Page: 2/11

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TABLE OF CONTENTS

1	Introduction.....	4
2	Device Under Test	4
3	Product Description	4
3.1	General Information	4
4	Measurement Method	5
4.1	Return Loss Requirements	5
4.2	Mechanical Requirements	5
5	Measurement Uncertainty.....	5
5.1	Return Loss	5
5.2	Dimension Measurement	5
5.3	Validation Measurement	5
6	Calibration Measurement Results.....	6
6.1	Return Loss and Impedance In Head Liquid	6
6.2	Return Loss and Impedance In Body Liquid	6
6.3	Mechanical Dimensions	6
7	Validation measurement	7
7.1	Head Liquid Measurement	7
7.2	SAR Measurement Result With Head Liquid	8
7.3	Body Liquid Measurement	9
7.4	SAR Measurement Result With Body Liquid	10
8	List of Equipment	11



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 750 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID750
Serial Number	SN 16/15 DIP 0G750-368
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



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 ≥ 10 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 %



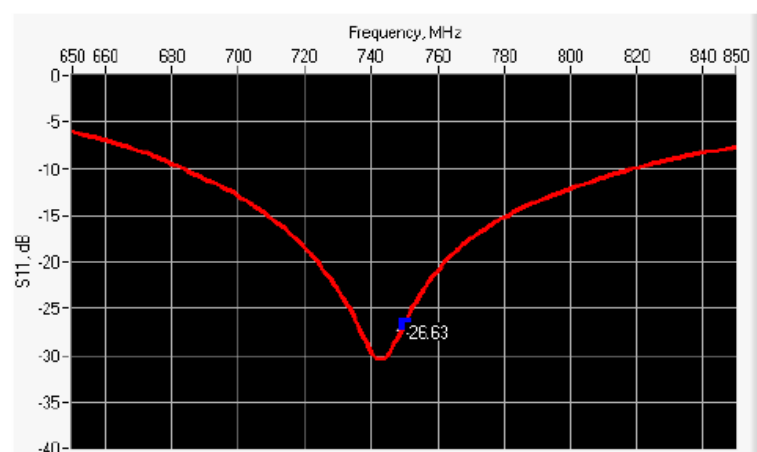
SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.3.15.SATU.A

10 g	20.1 %
------	--------

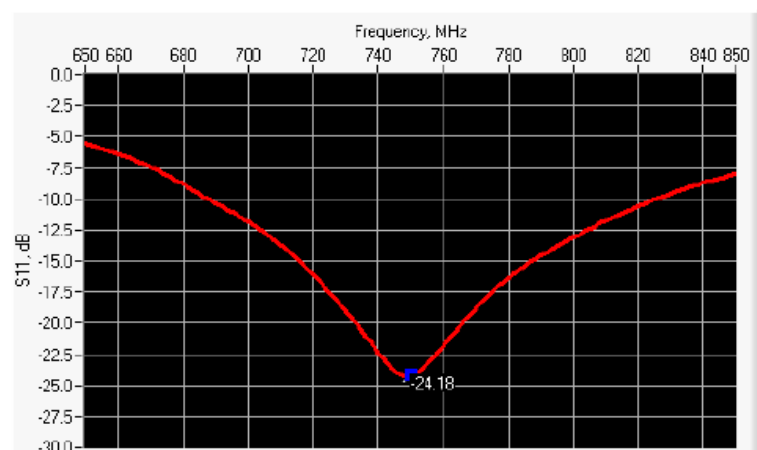
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
750	-26.63	-20	$54.1 \Omega + 1.4 j\Omega$

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
750	-24.18	-20	$52.4 \Omega + 5.8 j\Omega$

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 %	

Page: 6/11

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.3.15.SATU.A

450	290.0 ±1 %.		166.7 ±1 %.		6.35 ±1 %.	
750	176.0 ±1 %.	PASS	100.0 ±1 %.	PASS	6.35 ±1 %.	PASS
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 %.		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 %.	

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 %	PASS	0.89 ±5 %	PASS
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 %	

Page: 7/11

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.3.15.SATU.A

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: ϵ_{ps} : 41.8 σ : 0.90
Distance between dipole center and liquid	15.0 mm
Area scan resolution	$dx=8mm/dy=8mm$
Zoon Scan Resolution	$dx=8mm/dy=8mm/dz=5mm$
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	8.31 (0.73)	5.55	5.71 (0.54)
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	

Page: 8/11

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