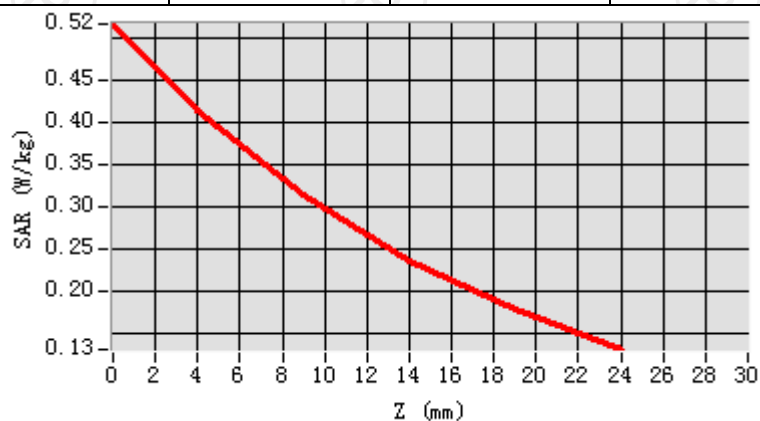
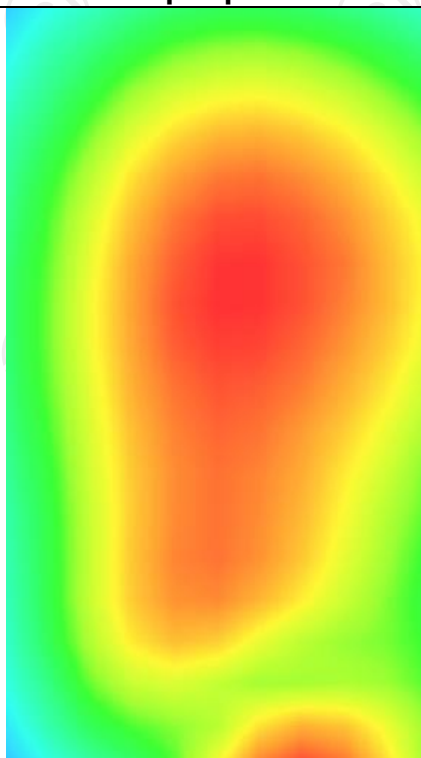


Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.5170	0.4145	0.3128	0.2355	0.1768



Hot spot position

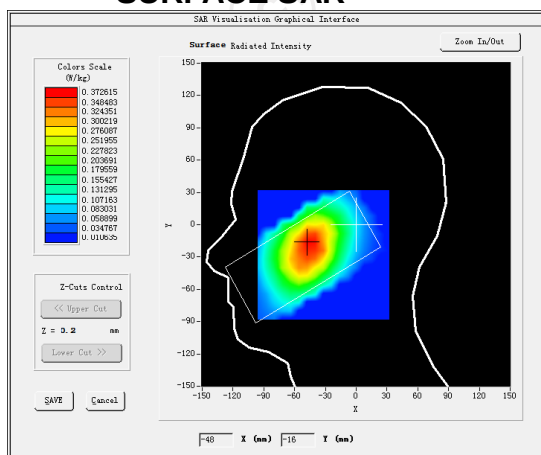


CDMA BC0

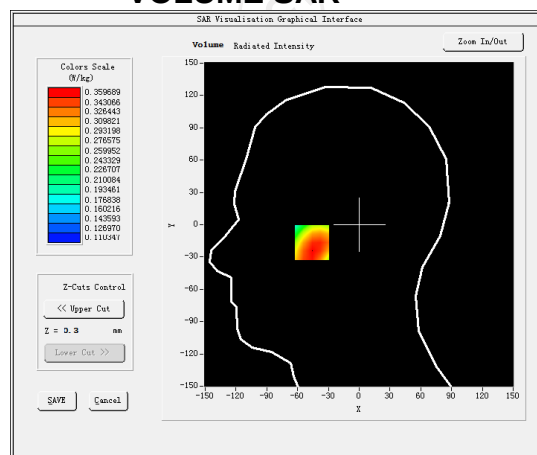
MEASUREMENT 1

Middle Band SAR (Channel 384):		Date: 09/11/2019
Frequency (MHz)	836.520000	
Relative permittivity (real part)	41.422883	
Relative permittivity (imaginary part)	18.129634	
Conductivity (S/m)	0.867241	
Variation (%)	-2.490000	
Crest Factor:	8.3	
Probe Conversion factor	5.50	
E-Field Probe:	SSE5 (SN 07/15 EP248)	
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	Right head	
Device Position	Cheek	
Band	CDMA2000 BC0	

SURFACE SAR



VOLUME SAR



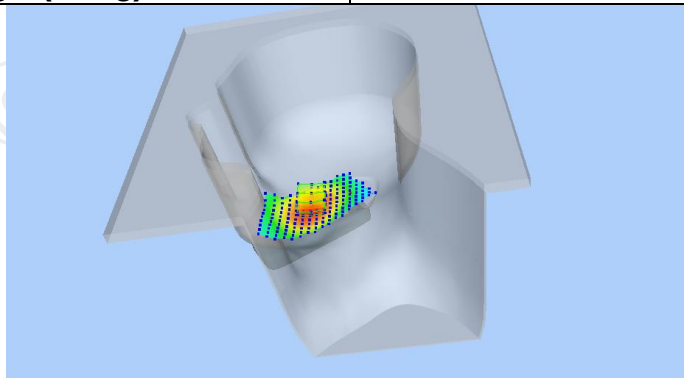
Maximum location: X=-46.00, Y=-16.00 SAR Peak: 0.40 W/kg

SAR 10g (W/Kg)

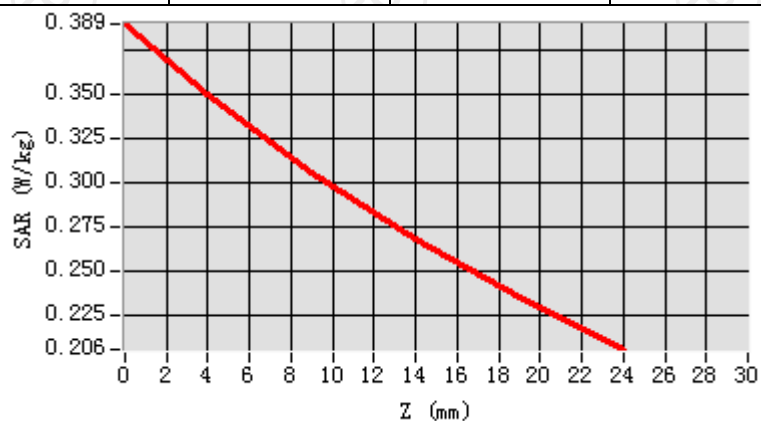
0.298223

SAR 1g (W/Kg)

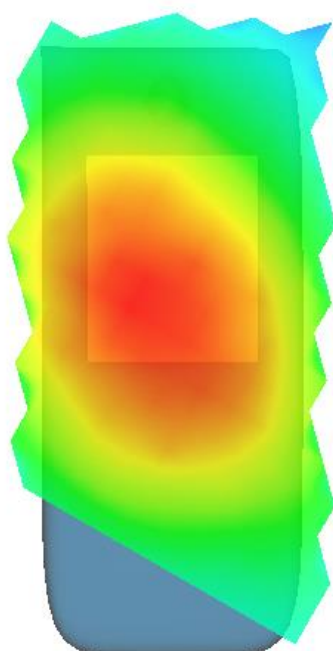
0.363963



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.3894	0.3493	0.3052	0.2674	0.2348



Hot spot position



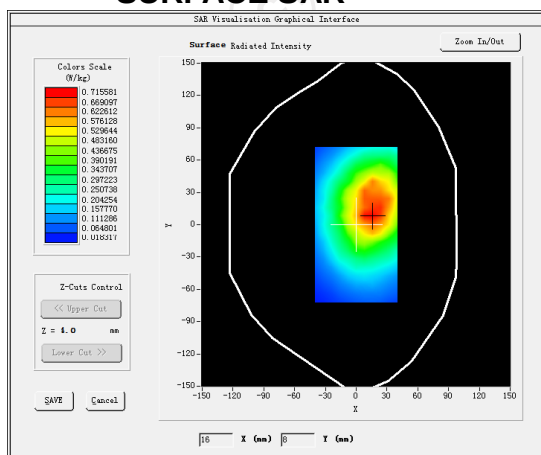
MEASUREMENT 2

Middle Band SAR (Channel 384):

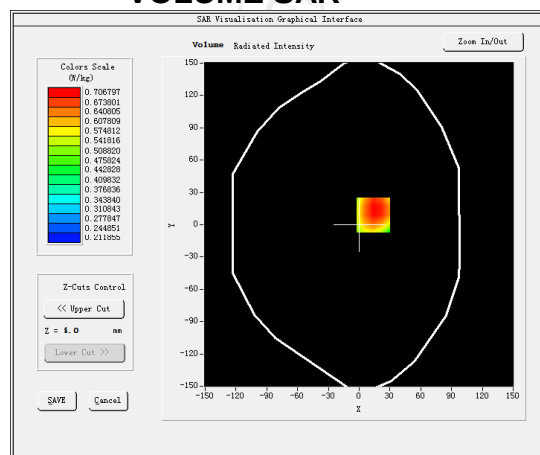
Date: 09/11/2019

Frequency (MHz)	836.520000
Relative permittivity (real part)	55.242927
Relative permittivity (imaginary part)	21.378266
Conductivity (S/m)	0.941230
Variation (%)	-0.790000
Crest Factor:	2.0
Probe Conversion factor	5.65
E-Field Probe:	SSE5 (SN 07/15 EP248)
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(10mm)</u>
Band	<u>CDMA2000 BC0</u>

SURFACE SAR



VOLUME SAR



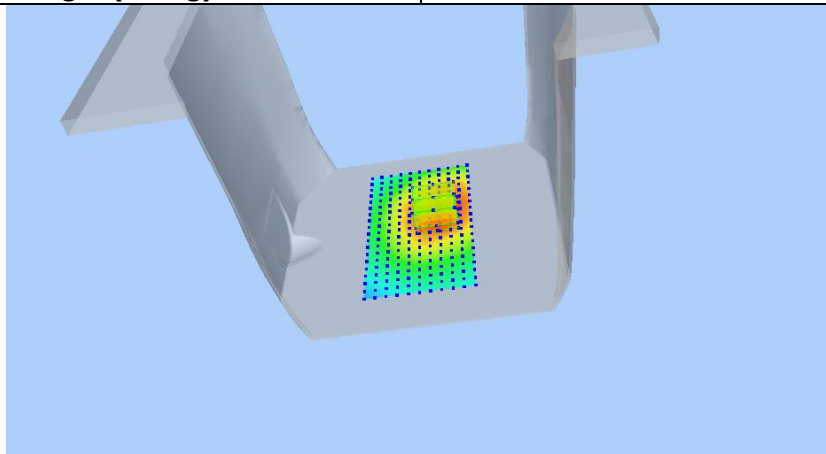
Maximum location: X=14.00, Y=9.00 SAR Peak: 0.91 W/kg

SAR 10g (W/Kg)

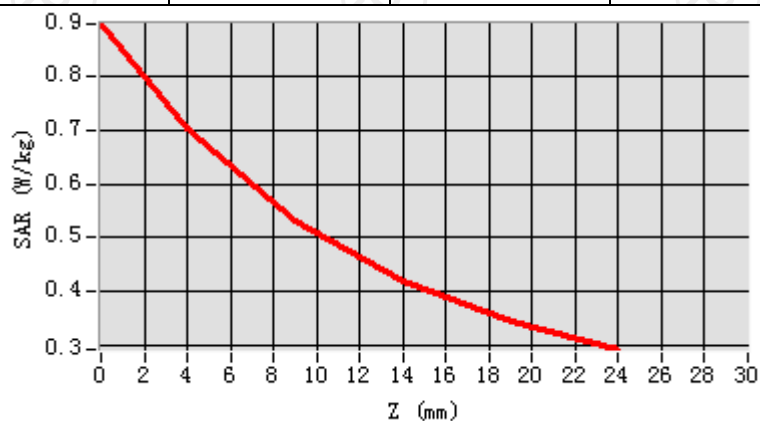
0.500136

SAR 1g (W/Kg)

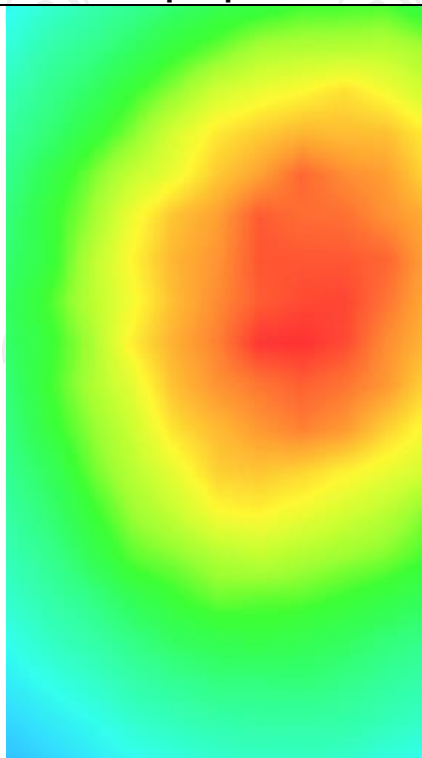
0.695411



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.8977	0.7047	0.5307	0.4168	0.3442



Hot spot position



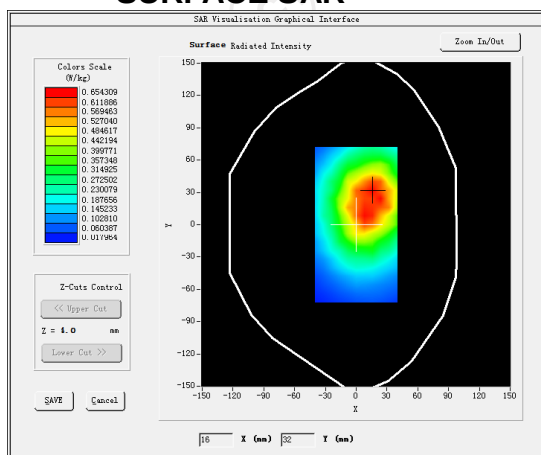
MEASUREMENT 3

Middle Band SAR (Channel 384):

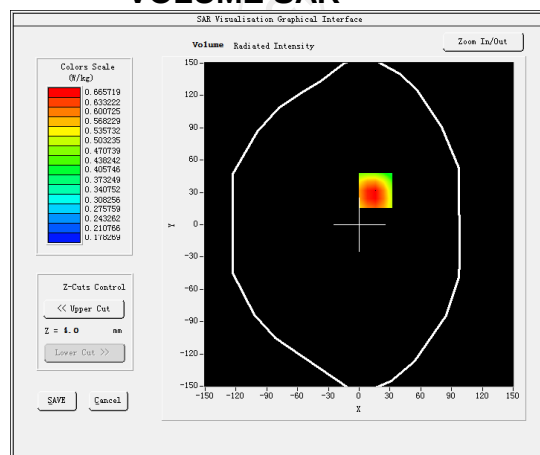
Date: 09/11/2019

Frequency (MHz)	836.520000
Relative permittivity (real part)	55.242927
Relative permittivity (imaginary part)	21.378266
Conductivity (S/m)	0.941230
Variation (%)	3.290000
Crest Factor:	2.0
Probe Conversion factor	5.65
E-Field Probe:	SSE5 (SN 07/15 EP248)
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(10mm)</u>
Band	<u>CDMA2000 BC0</u>

SURFACE SAR



VOLUME SAR



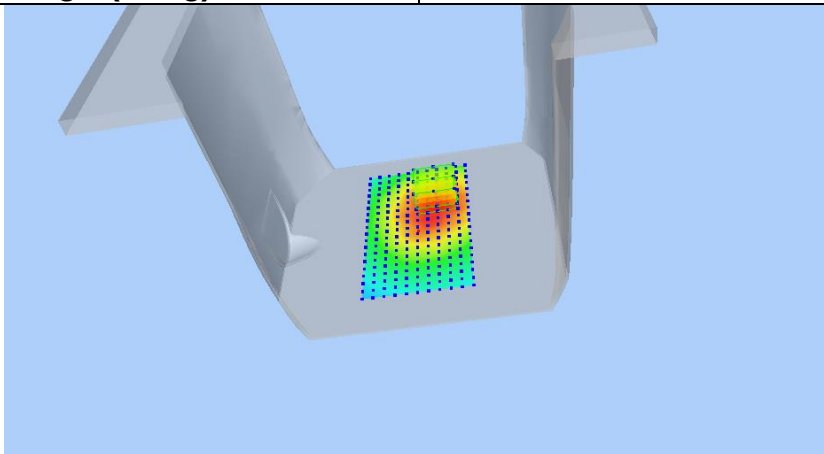
Maximum location: X=16.00, Y=32.00 SAR Peak: 0.84 W/kg

SAR 10g (W/Kg)

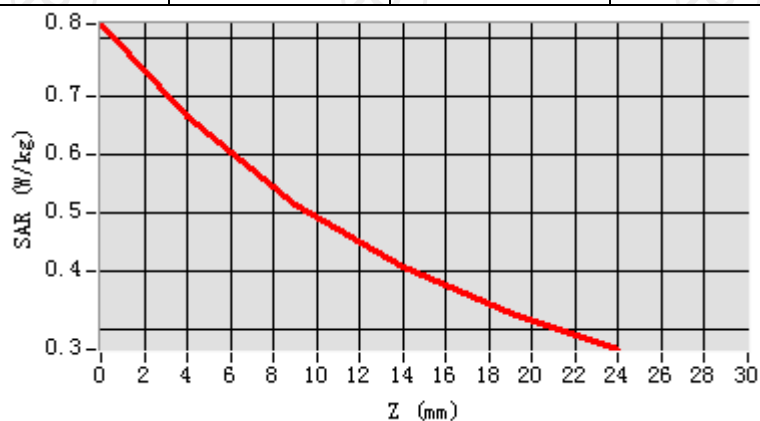
0.503622

SAR 1g (W/Kg)

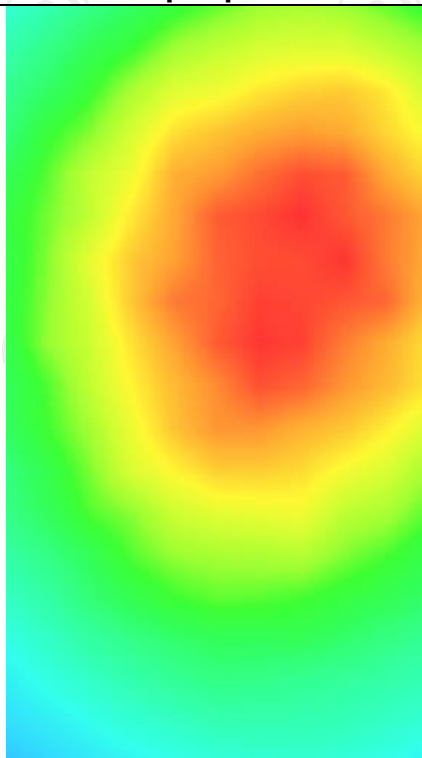
0.677139



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.8225	0.6657	0.5153	0.4069	0.3288



Hot spot position



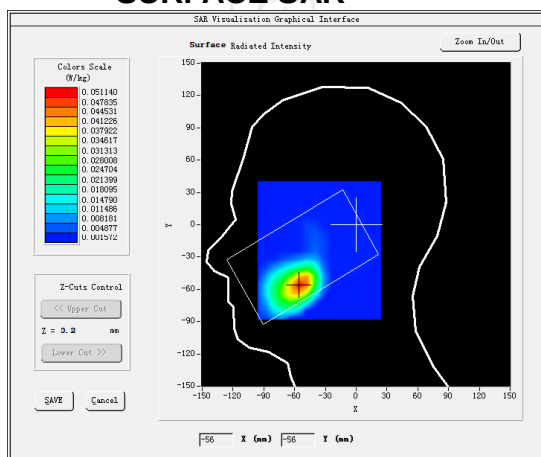
LTE Band 2

MEASUREMENT 1

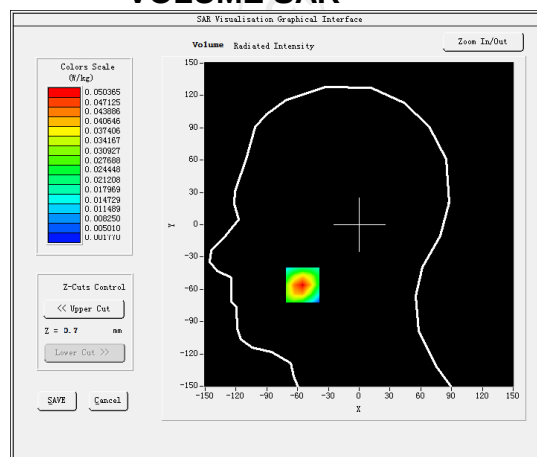
Lower Band SAR (Channel 18607): Date: 09/18/2019

Frequency (MHz)	1850.700000
Relative permittivity (real part)	39.113793
Relative permittivity (imaginary part)	12.607061
Conductivity (S/m)	1.337526
Variation (%)	-1.350000
Crest Factor	1.0
Probe Conversion factor	4.85
E-Field Probe:	SSE5 (SN 07/15 EP248)
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>Left head</u>
Device Position	<u>Cheek</u>
Band	<u>LTE band 2 (1 RB#2)</u>

SURFACE SAR



VOLUME SAR



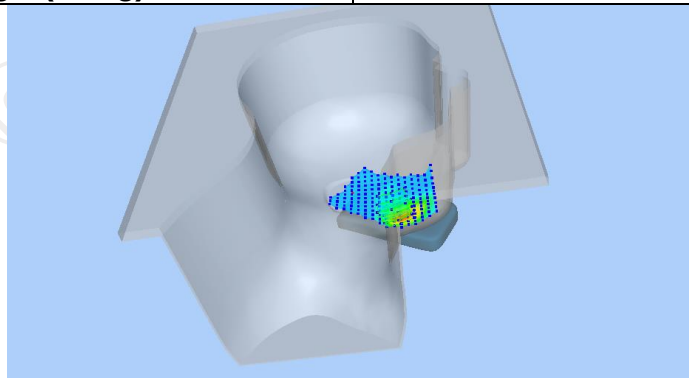
Maximum location: X=-55.00, Y=-56.00 SAR Peak: 0.08 W/kg

SAR 10g (W/Kg)

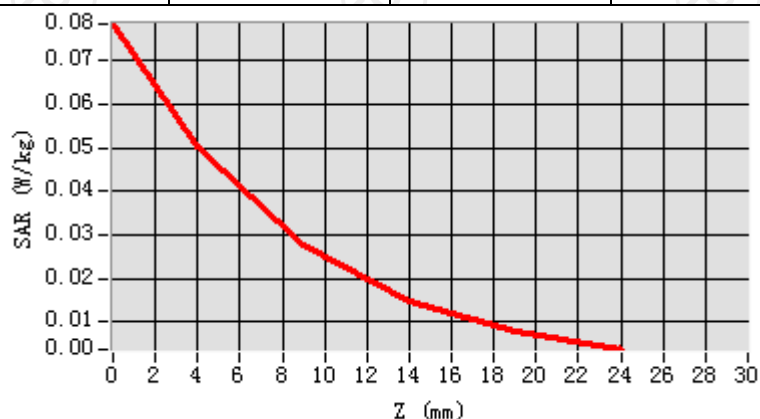
0.024095

SAR 1g (W/Kg)

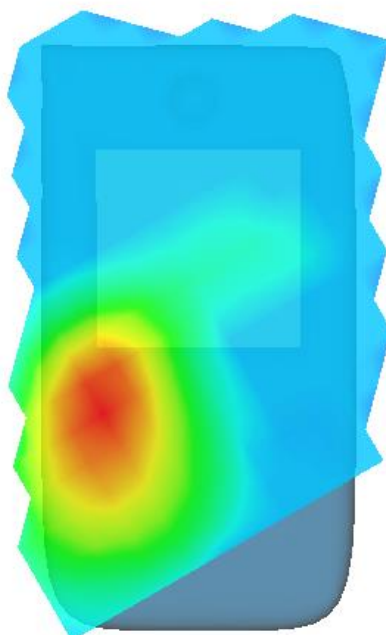
0.046699



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.0785	0.0504	0.0278	0.0148	0.0078



Hot spot position



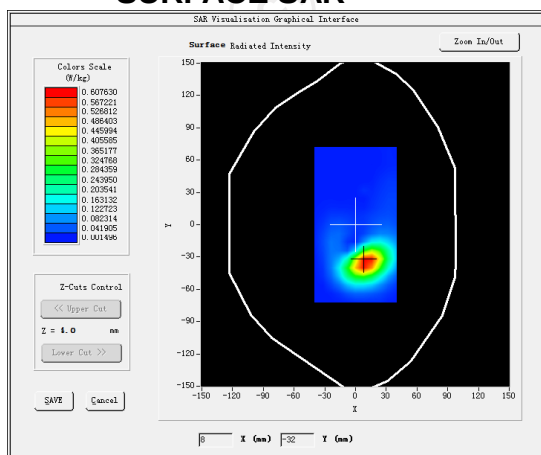
MEASUREMENT 2

Lower Band SAR (Channel 18607):

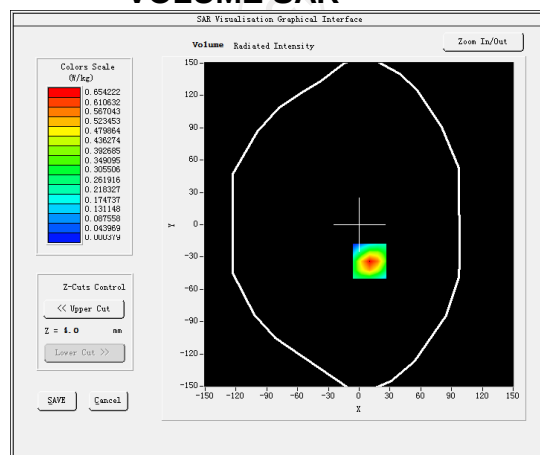
Date: 09/18/2019

Frequency (MHz)	1850.700000
Relative permittivity (real part)	53.342133
Relative permittivity (imaginary part)	14.329440
Conductivity (S/m)	1.491983
Variation (%)	-2.130000
Crest Factor	1.0
Probe Conversion factor	5.01
E-Field Probe:	SSE5 (SN 07/15 EP248)
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 front(10mm)
Band	LTE band 2 (1 RB#2)

SURFACE SAR



VOLUME SAR



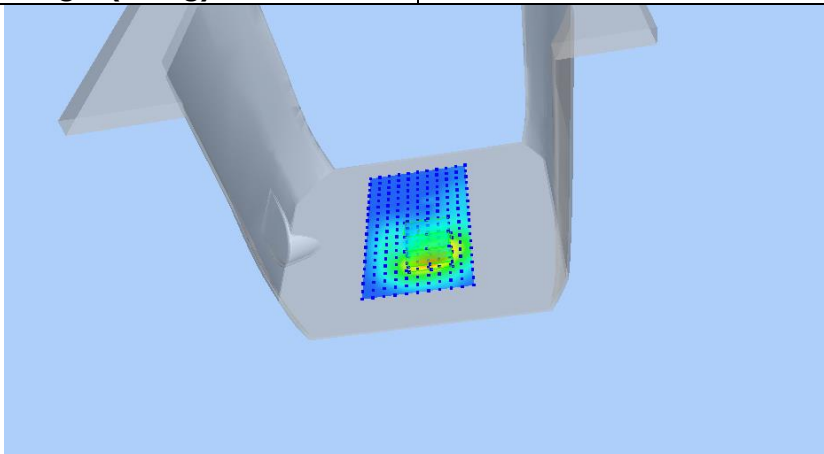
Maximum location: X=10.00, Y=-34.00 SAR Peak: 1.04 W/kg

SAR 10g (W/Kg)

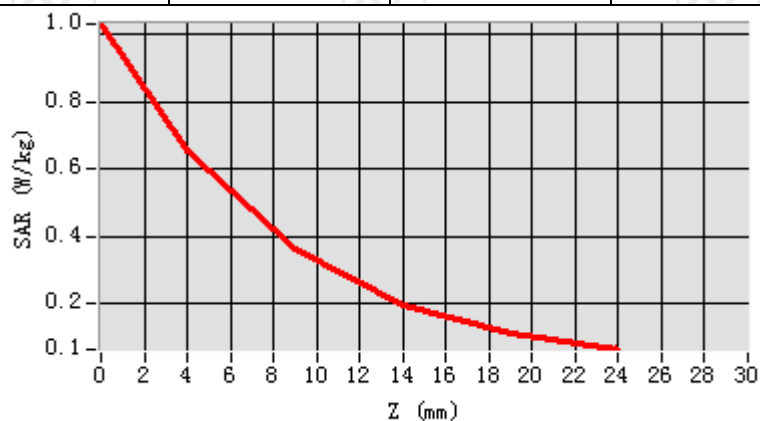
0.301672

SAR 1g (W/Kg)

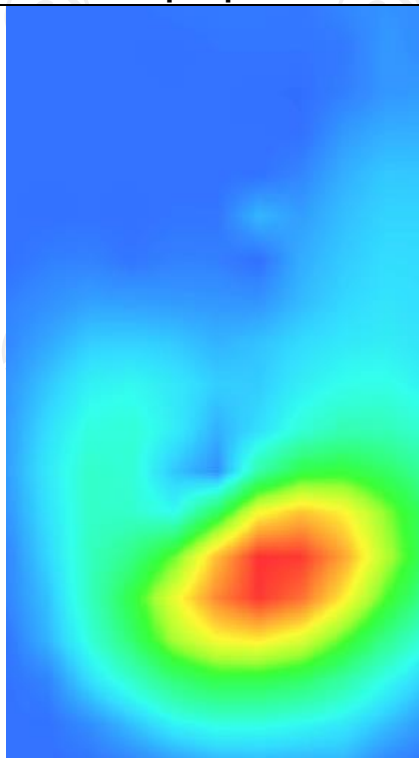
0.602582



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	1.0328	0.6542	0.3586	0.1964	0.1115



Hot spot position



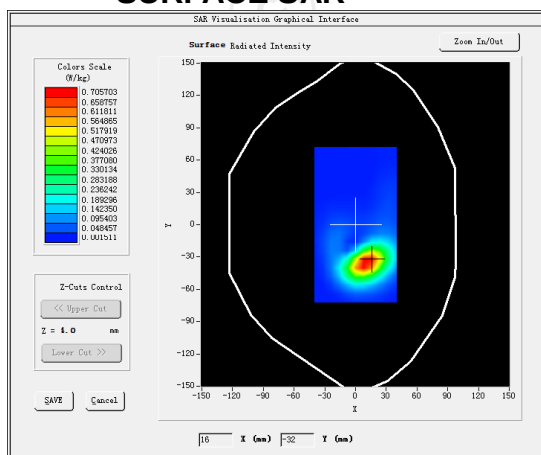
MEASUREMENT 3

Lower Band SAR (Channel 18607):

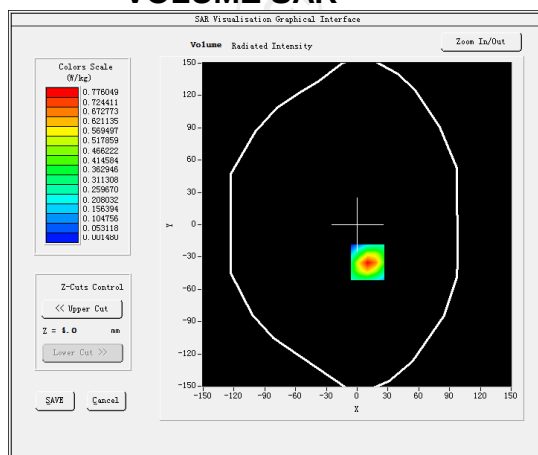
Date: 09/18/2019

Frequency (MHz)	1850.700000
Relative permittivity (real part)	53.342133
Relative permittivity (imaginary part)	14.329440
Conductivity (S/m)	1.491983
Variation (%)	-1.270000
Crest Factor	1.0
Probe Conversion factor	5.01
E-Field Probe:	SSE5 (SN 07/15 EP248)
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 front(hotspot 10mm)</u>
Band	<u>LTE band 2 (1 RB#2)</u>

SURFACE SAR

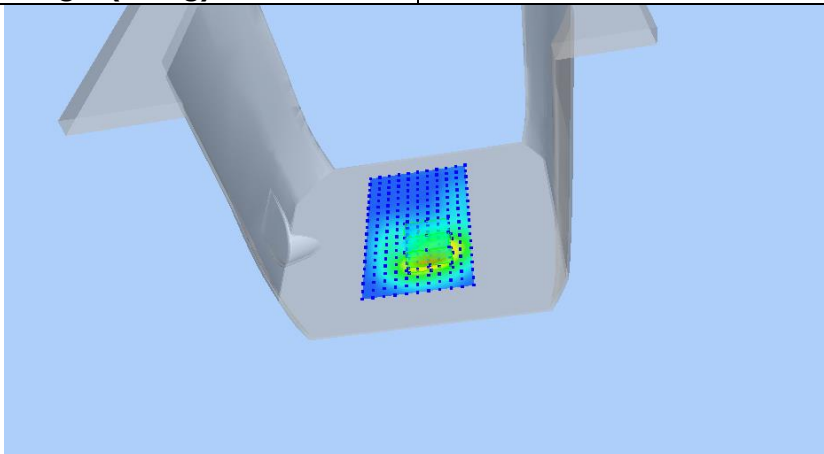


VOLUME SAR

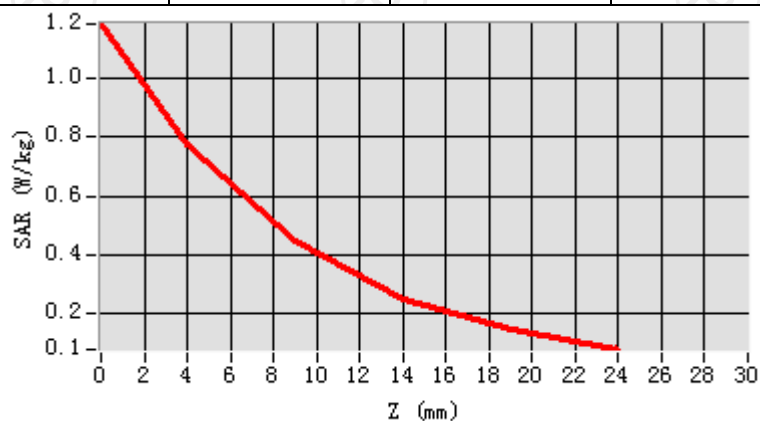


Maximum location: X=10.00, Y=-35.00 SAR Peak: 1.20 W/kg

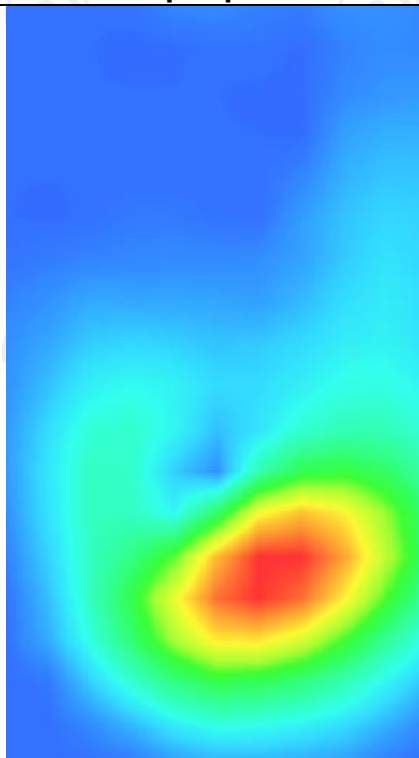
SAR 10g (W/Kg)	0.356615
SAR 1g (W/Kg)	0.711090



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	1.1879	0.7760	0.4425	0.2492	0.1412



Hot spot position



LTE Band 4

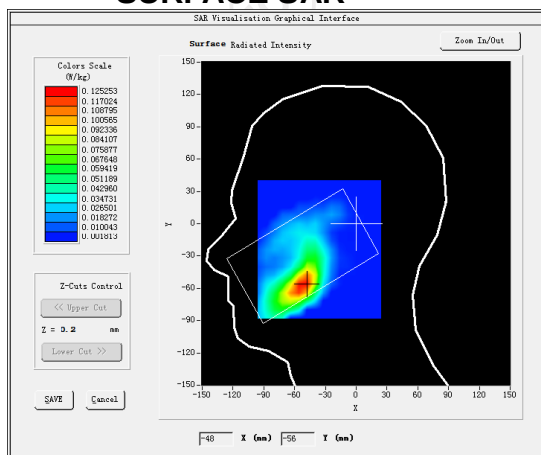
MEASUREMENT 1

Middle Band SAR (Channel 20175):

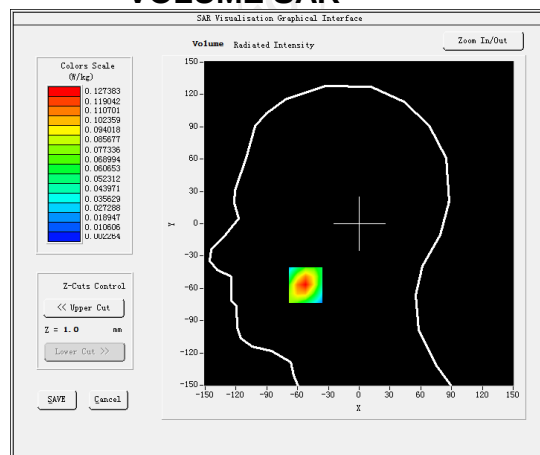
Date: 09/13/2019

Frequency (MHz)	1732.500000
Relative permittivity (real part)	39.101249
Relative permittivity (imaginary part)	12.468850
Conductivity (S/m)	1.350792
Variation (%)	-2.840000
Crest Factor	1.0
Probe Conversion factor	4.38
E-Field Probe:	SSE5 (SN 07/15 EP248)
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	Left head
Device Position	Cheek
Band	LTE band 4(1 RB#50)

SURFACE SAR



VOLUME SAR



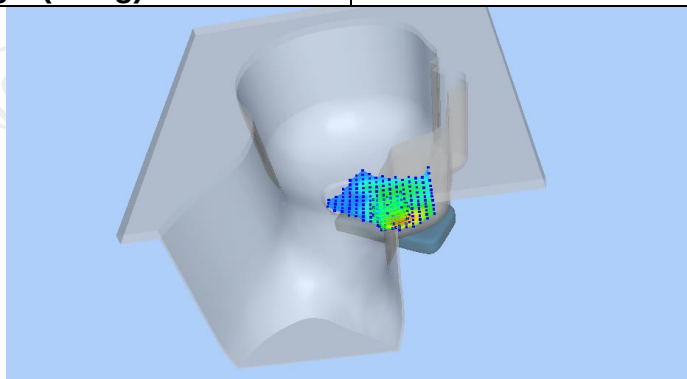
Maximum location: X=-52.00, Y=-57.00 SAR Peak: 0.19 W/kg

SAR 10g (W/Kg)

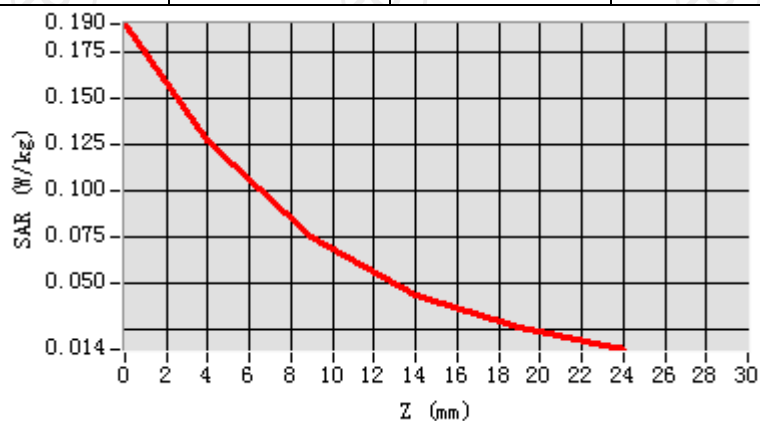
0.063903

SAR 1g (W/Kg)

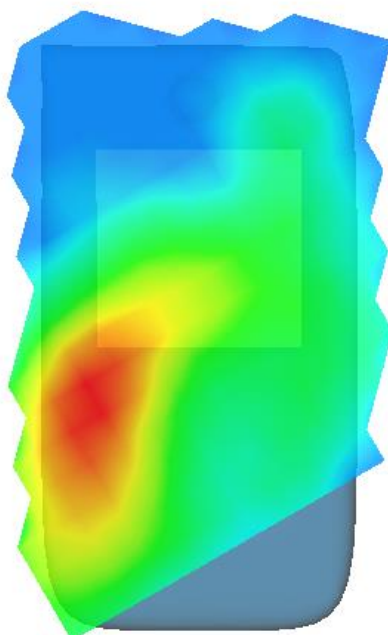
0.118369



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.1901	0.1274	0.0753	0.0440	0.0258



Hot spot position



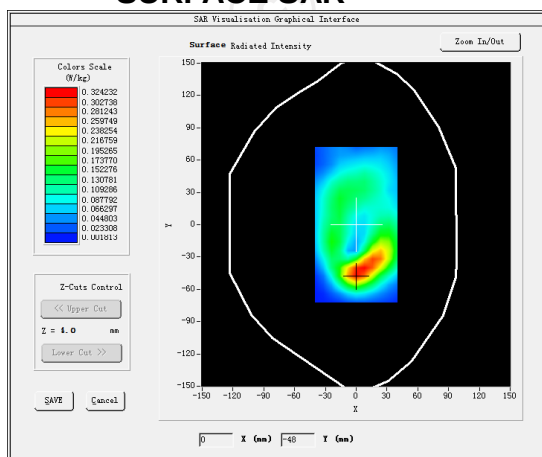
MEASUREMENT 2

Middle Band SAR (Channel 20175):

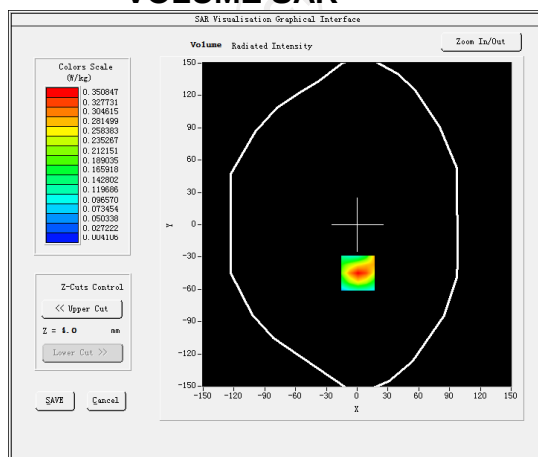
Date: 09/13/2019

Frequency (MHz)	1732.500000
Relative permittivity (real part)	53.321249
Relative permittivity (imaginary part)	12.468850
Conductivity (S/m)	1.502592
Variation (%)	-2.540000
Crest Factor	1.0
Probe Conversion factor	4.52
E-Field Probe:	SSE5 (SN 07/15 EP248)
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(10mm)</u>
Band	<u>LTE band 4(1 RB#50)</u>

SURFACE SAR



VOLUME SAR



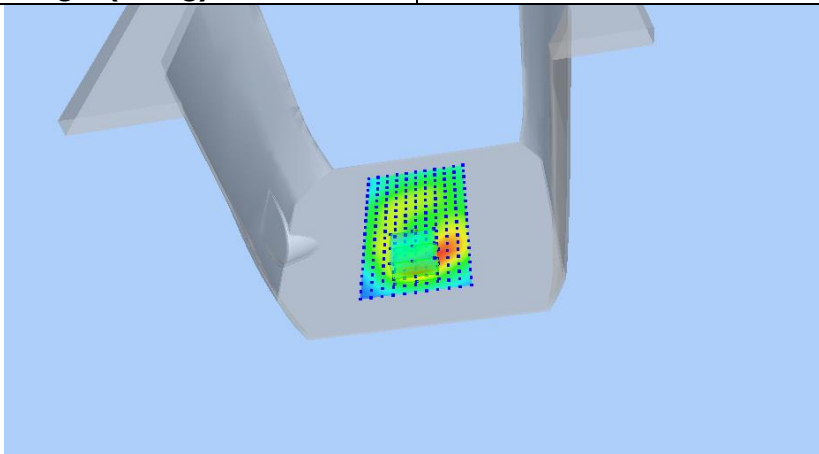
Maximum location: X=1.00, Y=-45.00 SAR Peak: 0.58 W/kg

SAR 10g (W/Kg)

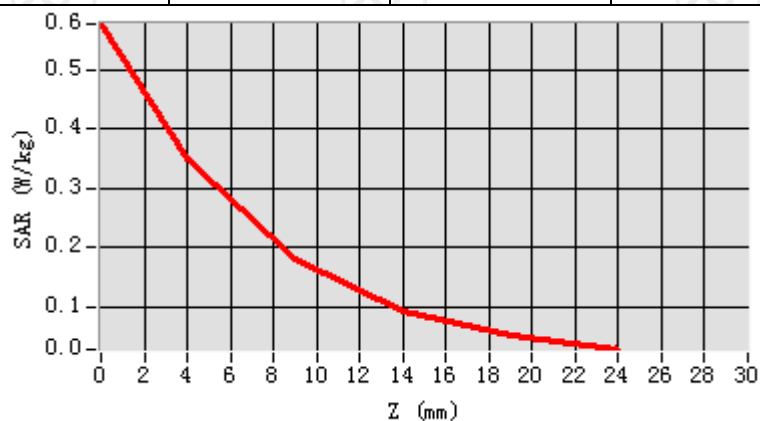
0.163996

SAR 1g (W/Kg)

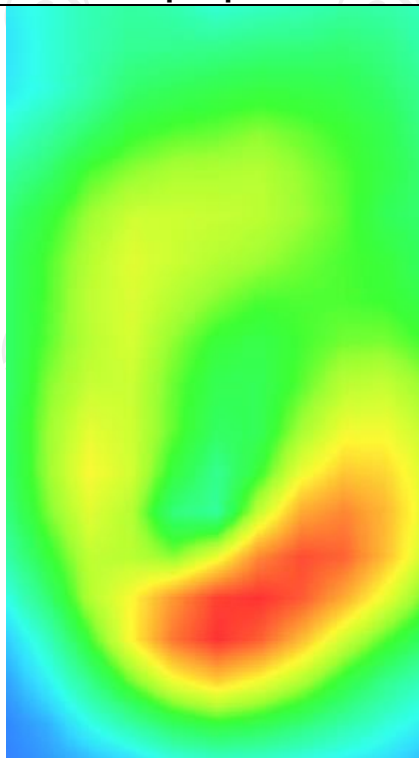
0.325254



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.5775	0.3508	0.1812	0.0939	0.0519



Hot spot position



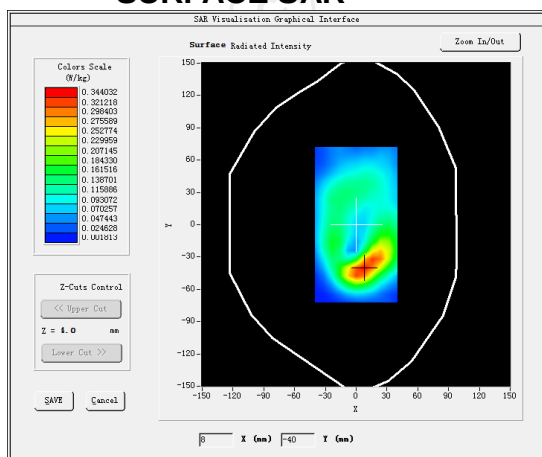
MEASUREMENT 3

Middle Band SAR (Channel 20175):

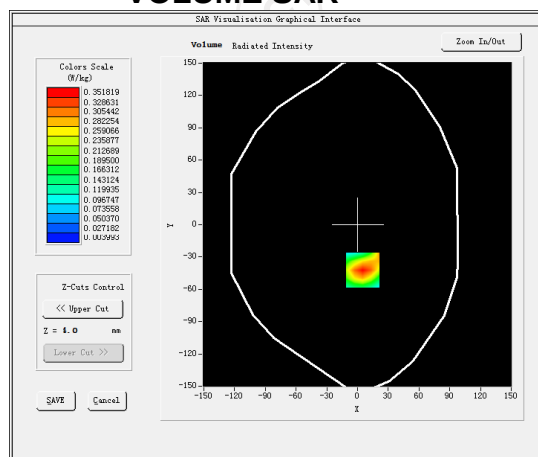
Date: 09/13/2019

Frequency (MHz)	1732.500000
Relative permittivity (real part)	53.321249
Relative permittivity (imaginary part)	12.468850
Conductivity (S/m)	1.502592
Variation (%)	-0.040000
Crest Factor	1.0
Probe Conversion factor	4.52
E-Field Probe:	SSE5 (SN 07/15 EP248)
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 4(1 RB#50)</u>

SURFACE SAR



VOLUME SAR



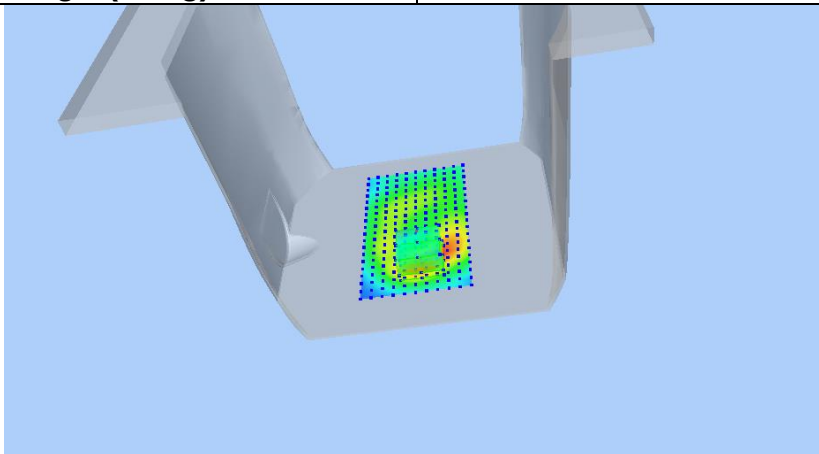
Maximum location: X=5.00, Y=-42.00 SAR Peak: 0.53 W/kg

SAR 10g (W/Kg)

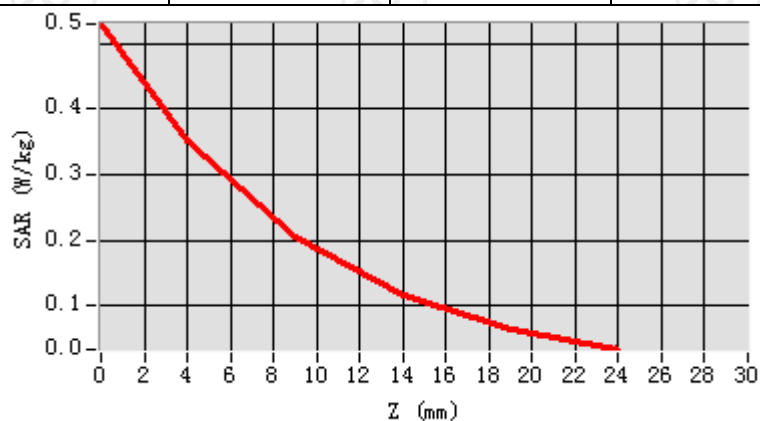
0.174889

SAR 1g (W/Kg)

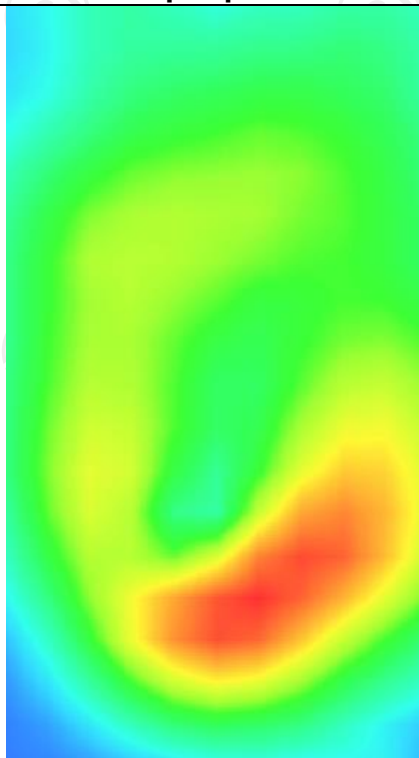
0.325979



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.5295	0.3518	0.2047	0.1167	0.0658



Hot spot position



LTE Band 5

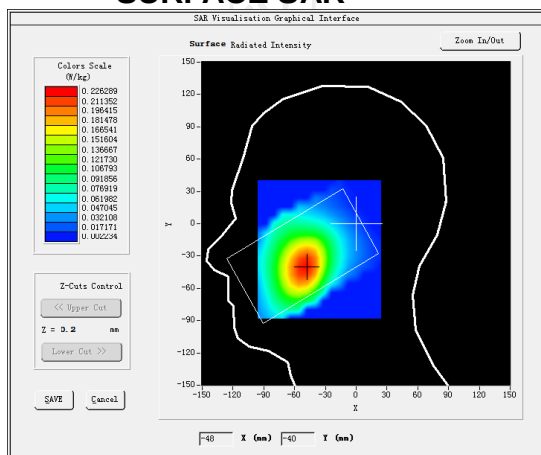
MEASUREMENT 1

Higher Band SAR (Channel 20625):

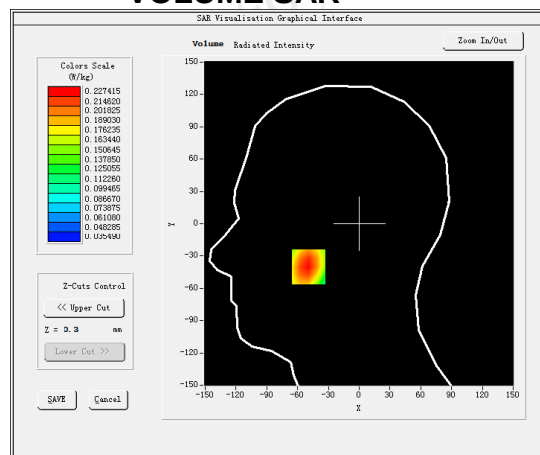
Date: 09/11/2019

Frequency (MHz)	844.000000
Relative permittivity (real part)	40.392517
Relative permittivity (imaginary part)	12.468850
Conductivity (S/m)	0.881392
Variation (%)	2.320000
Crest Factor	1.0
Probe Conversion factor	4.38
E-Field Probe:	SSE5 (SN 07/15 EP248)
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>Right head</u>
Device Position	<u>Cheek</u>
Band	<u>LTE band 5(1 RB#13)</u>

SURFACE SAR



VOLUME SAR



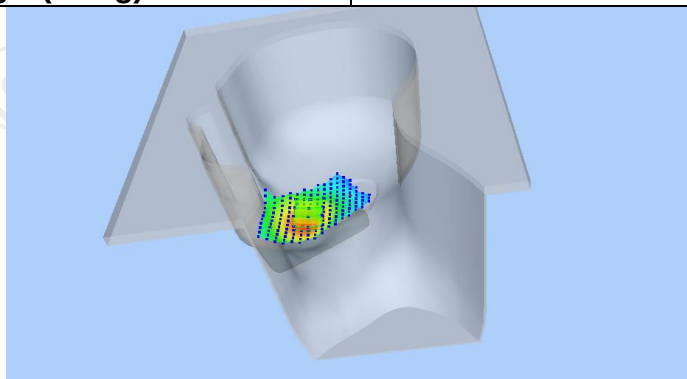
Maximum location: X=-49.00, Y=-40.00 SAR Peak: 0.27 W/kg

SAR 10g (W/Kg)

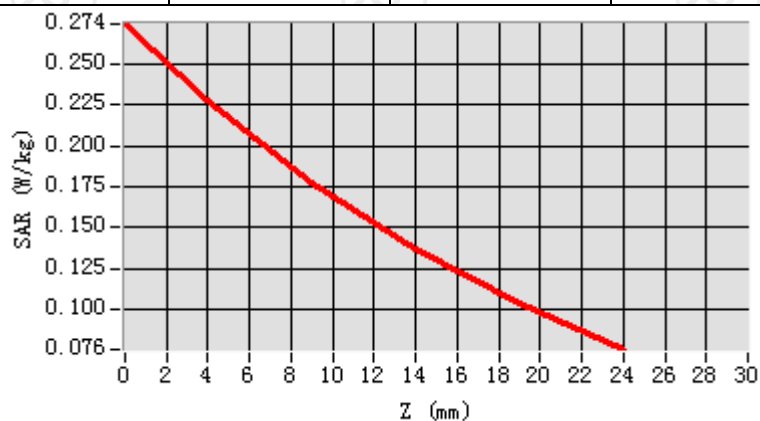
0.158557

SAR 1g (W/Kg)

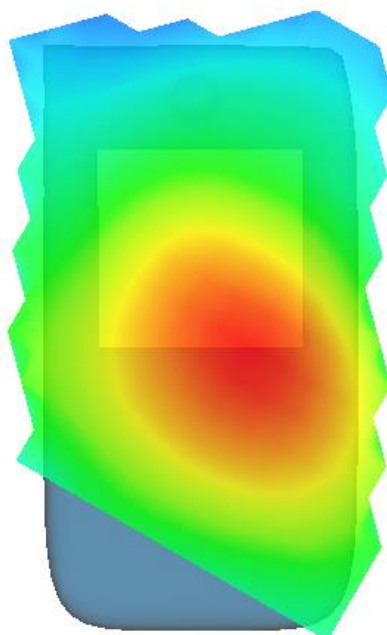
0.218348



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.2742	0.2274	0.1778	0.1371	0.1037



Hot spot position



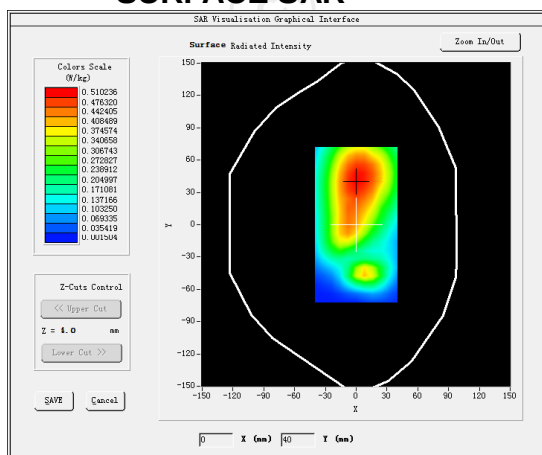
MEASUREMENT 2

Higher Band SAR (Channel 20625):

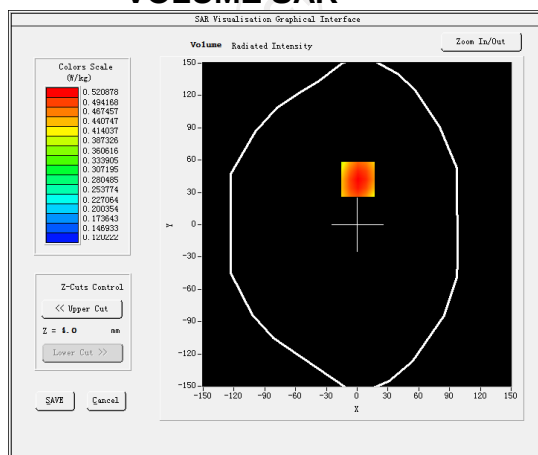
Date: 09/11/2019

Frequency (MHz)	844.000000
Relative permittivity (real part)	53.214937
Relative permittivity (imaginary part)	12.468850
Conductivity (S/m)	0.973512
Variation (%)	2.100000
Crest Factor	1.0
Probe Conversion factor	4.52
E-Field Probe:	SSE5 (SN 07/15 EP248)
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(10mm)</u>
Band	<u>LTE band 5(1 RB#13)</u>

SURFACE SAR



VOLUME SAR



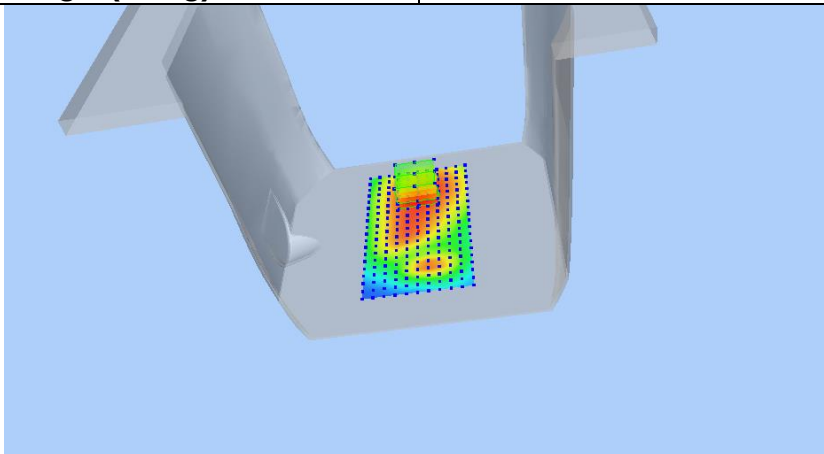
Maximum location: X=1.00, Y=42.00 SAR Peak: 0.64 W/kg

SAR 10g (W/Kg)

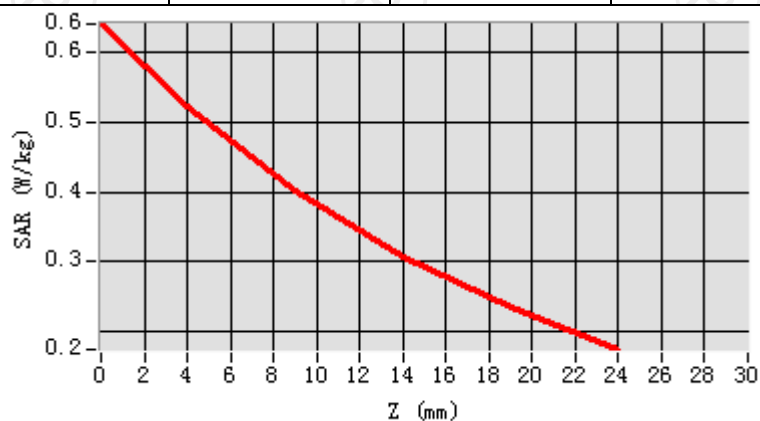
0.370155

SAR 1g (W/Kg)

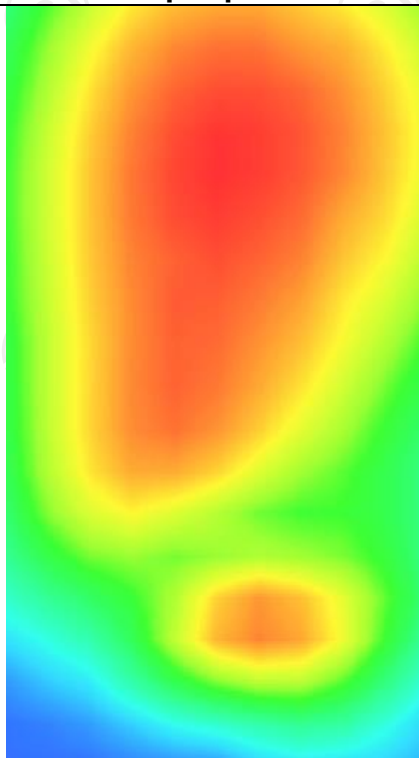
0.502694



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.6403	0.5209	0.4002	0.3065	0.2336



Hot spot position



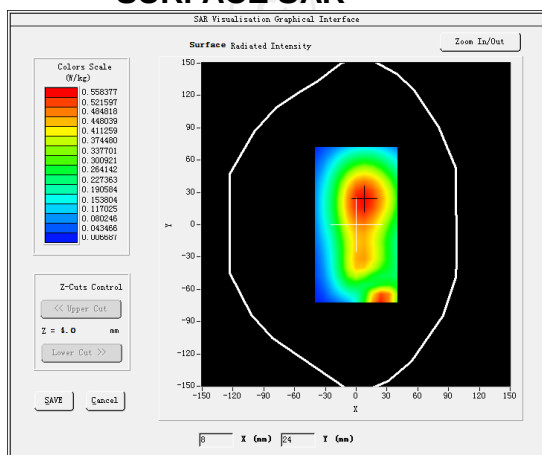
MEASUREMENT 3

Higher Band SAR (Channel 20625):

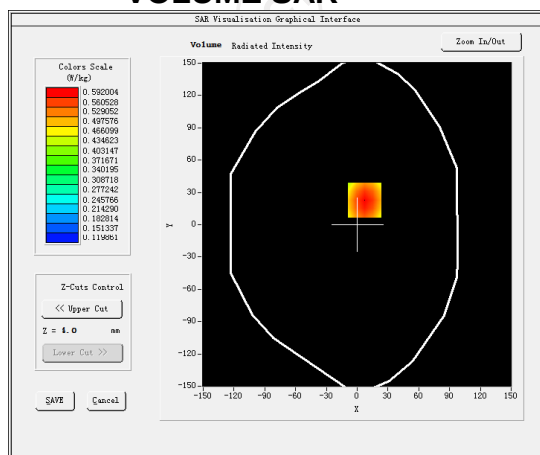
Date: 09/11/2019

Frequency (MHz)	844.000000
Relative permittivity (real part)	53.214937
Relative permittivity (imaginary part)	12.468850
Conductivity (S/m)	0.973512
Variation (%)	-0.260000
Crest Factor	1.0
Probe Conversion factor	4.52
E-Field Probe:	SSE5 (SN 07/15 EP248)
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(10mm)</u>
Band	<u>LTE band 5(1 RB#13)</u>

SURFACE SAR



VOLUME SAR



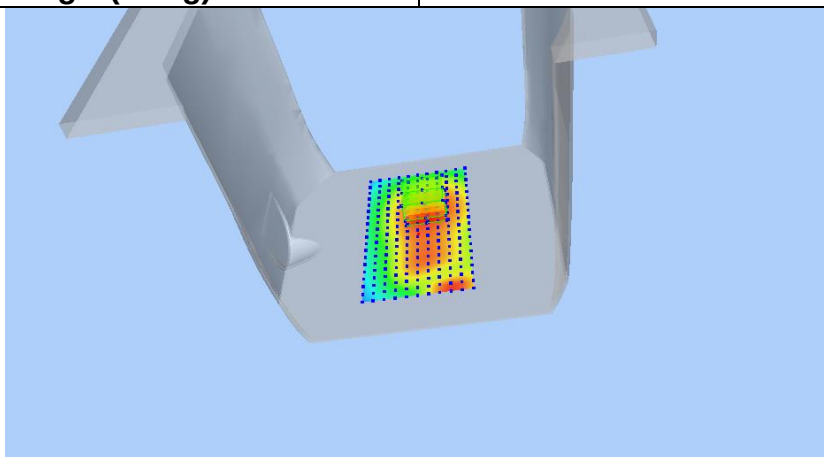
Maximum location: X=7.00, Y=23.00 SAR Peak: 0.73 W/kg

SAR 10g (W/Kg)

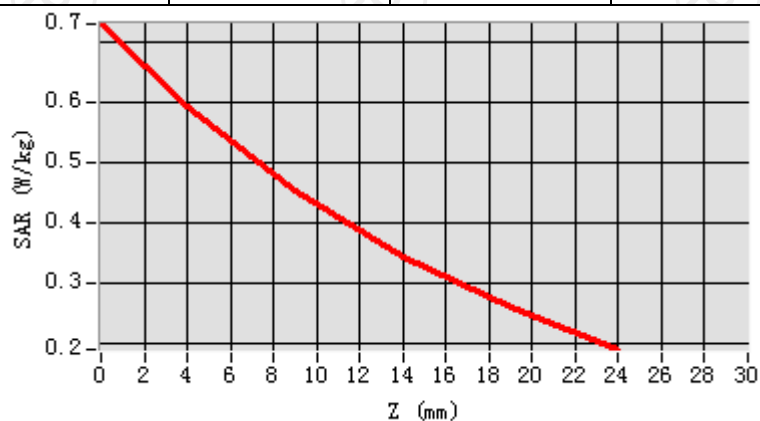
0.414519

SAR 1g (W/Kg)

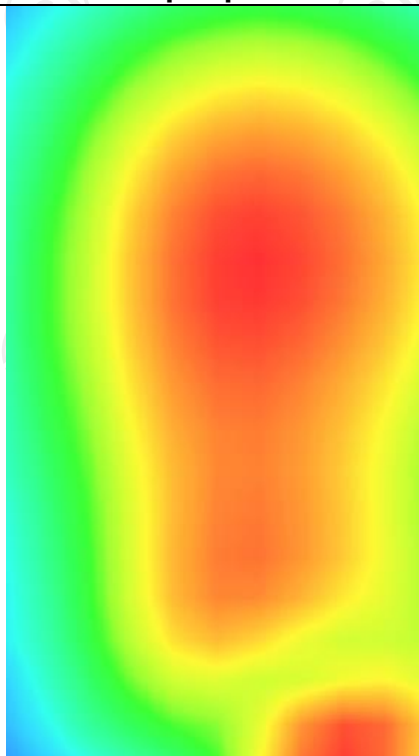
0.569940



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.7302	0.5920	0.4521	0.3432	0.2583



Hot spot position



LTE Band 7

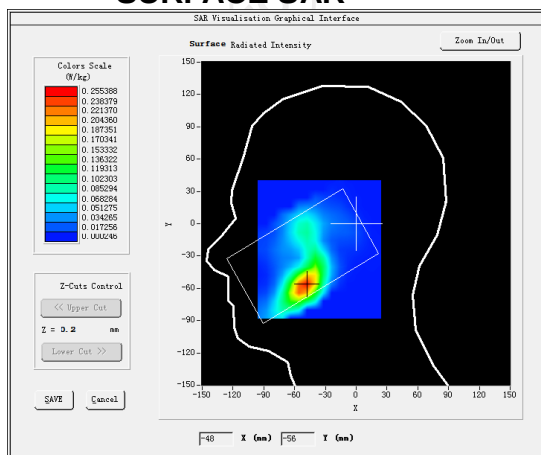
MEASUREMENT 1

Higher Band SAR (Channel 21100):

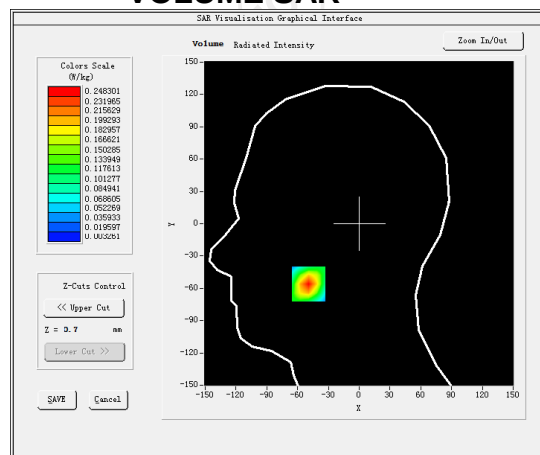
Date: 09/25/2019

Frequency (MHz)	2535.000000
Relative permittivity (real part)	38.852754
Relative permittivity (imaginary part)	12.468850
Conductivity (S/m)	1.922731
Variation (%)	-4.570000
Crest Factor	1.0
Probe Conversion factor	4.38
E-Field Probe:	SSE5 (SN 07/15 EP248)
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	Left head
Device Position	Cheek
Band	LTE band 7(1 RB#50)

SURFACE SAR



VOLUME SAR



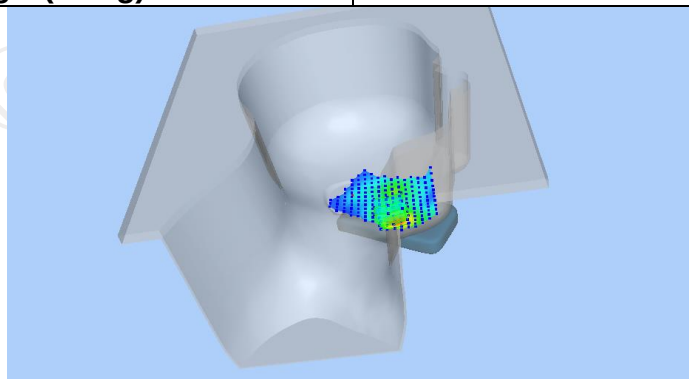
Maximum location: X=-49.00, Y=-56.00 SAR Peak: 0.41 W/kg

SAR 10g (W/Kg)

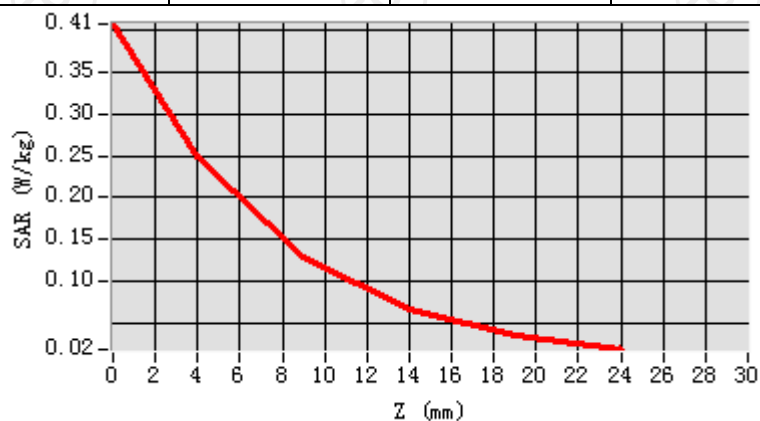
0.113664

SAR 1g (W/Kg)

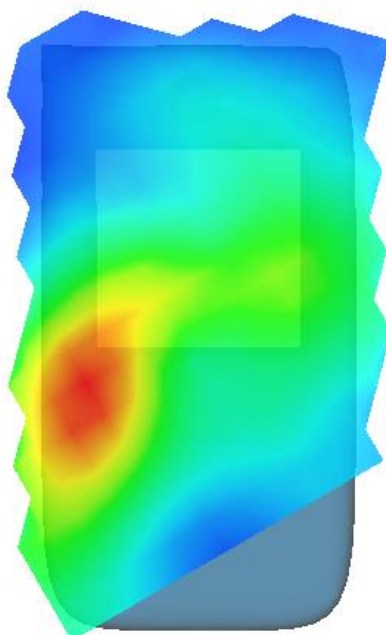
0.232488



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.4072	0.2483	0.1284	0.0660	0.0354



Hot spot position



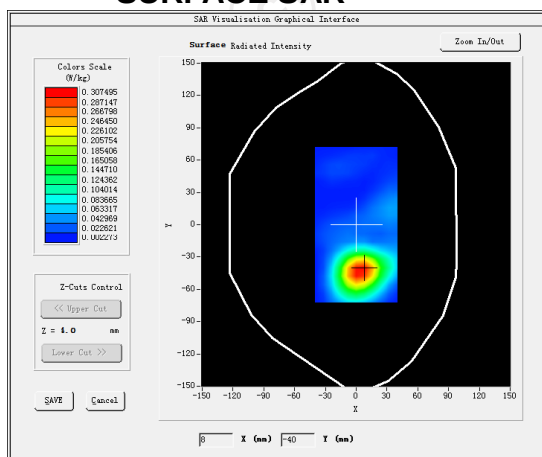
MEASUREMENT 2

Higher Band SAR (Channel 21100):

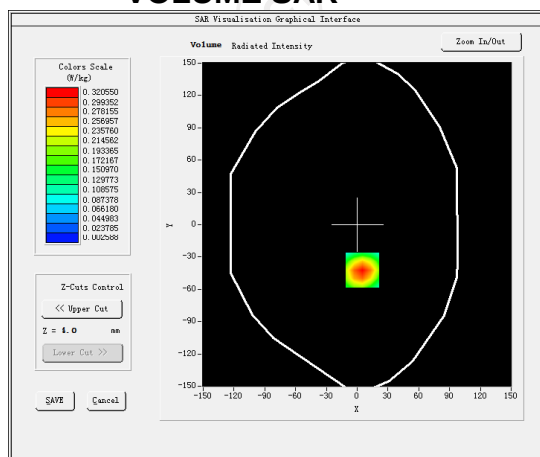
Date: 09/25/2019

Frequency (MHz)	2535.000000
Relative permittivity (real part)	52.011509
Relative permittivity (imaginary part)	12.468850
Conductivity (S/m)	2.108245
Variation (%)	-3.690000
Crest Factor	1.0
Probe Conversion factor	4.52
E-Field Probe:	SSE5 (SN 07/15 EP248)
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(10mm)</u>
Band	<u>LTE band 7(1 RB#50)</u>

SURFACE SAR



VOLUME SAR



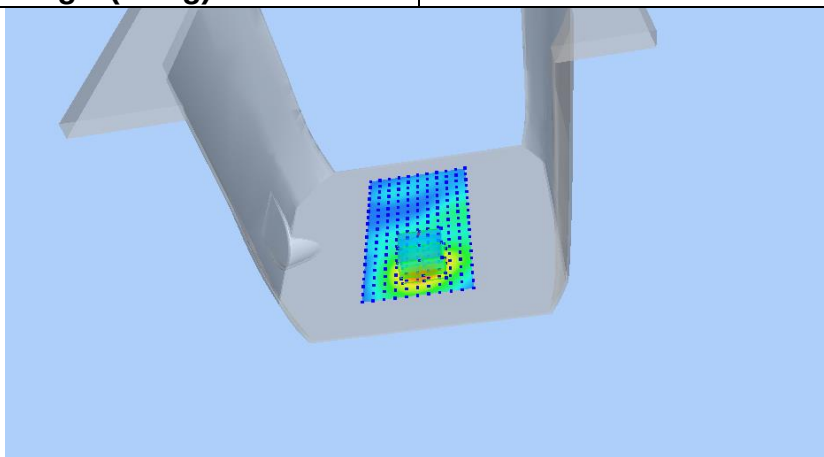
Maximum location: X=5.00, Y=-42.00 SAR Peak: 0.56 W/kg

SAR 10g (W/Kg)

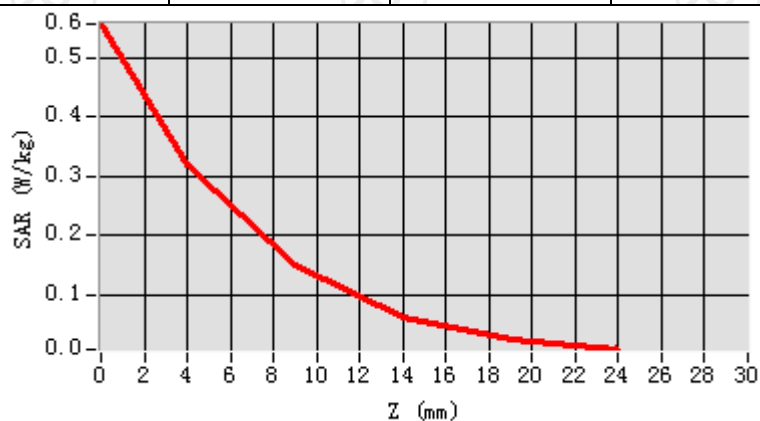
0.144922

SAR 1g (W/Kg)

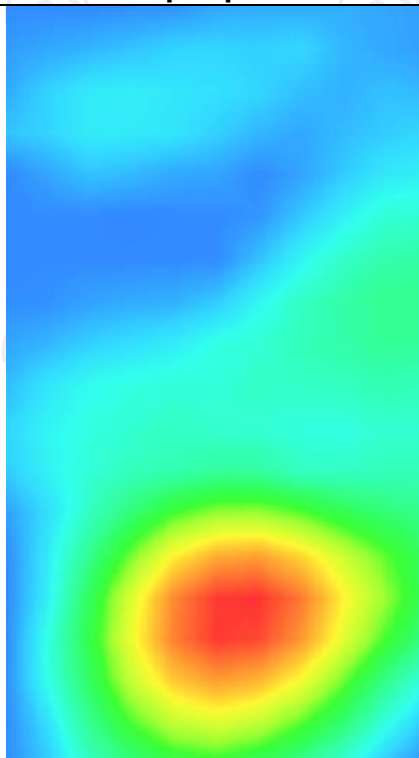
0.301120



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.5568	0.3206	0.1482	0.0630	0.0249



Hot spot position



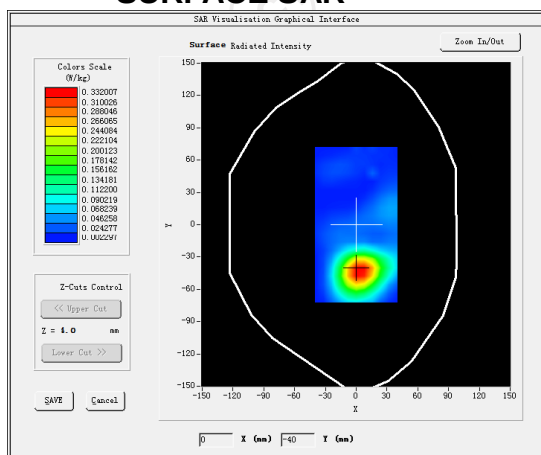
MEASUREMENT 3

Higher Band SAR (Channel 21100):

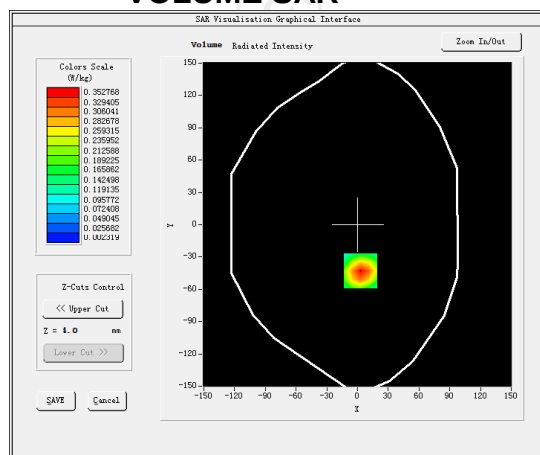
Date: 09/25/2019

Frequency (MHz)	2535.000000
Relative permittivity (real part)	52.011509
Relative permittivity (imaginary part)	12.468850
Conductivity (S/m)	2.108245
Variation (%)	-4.810000
Crest Factor	1.0
Probe Conversion factor	4.52
E-Field Probe:	SSE5 (SN 07/15 EP248)
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 7(1 RB#50)</u>

SURFACE SAR



VOLUME SAR



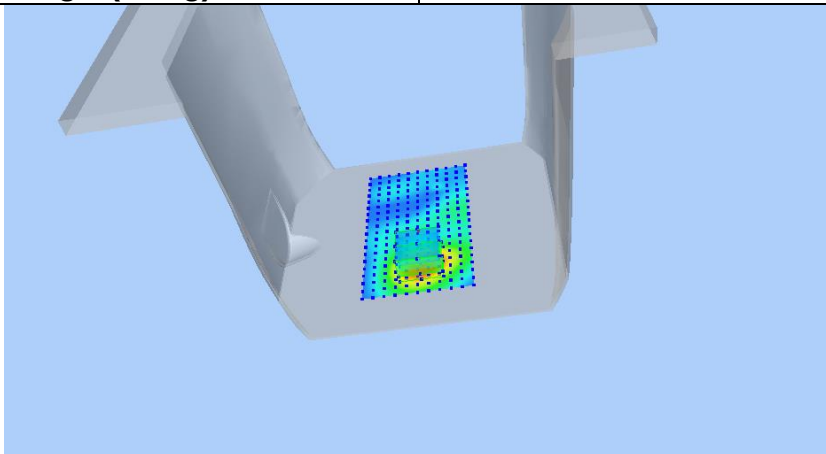
Maximum location: X=3.00, Y=-43.00 SAR Peak: 0.60 W/kg

SAR 10g (W/Kg)

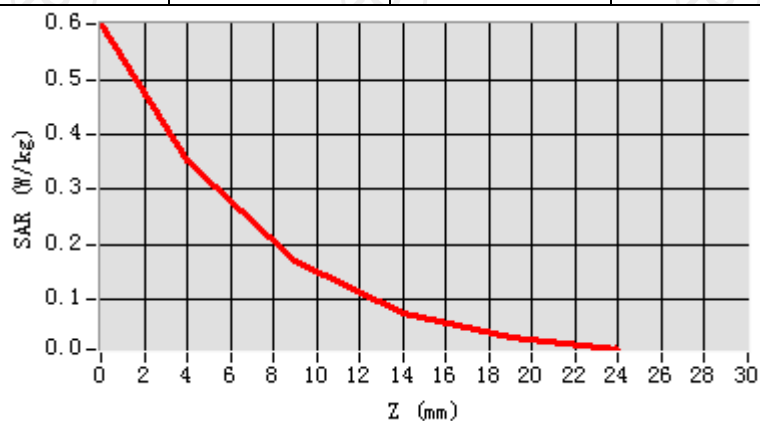
0.159240

SAR 1g (W/Kg)

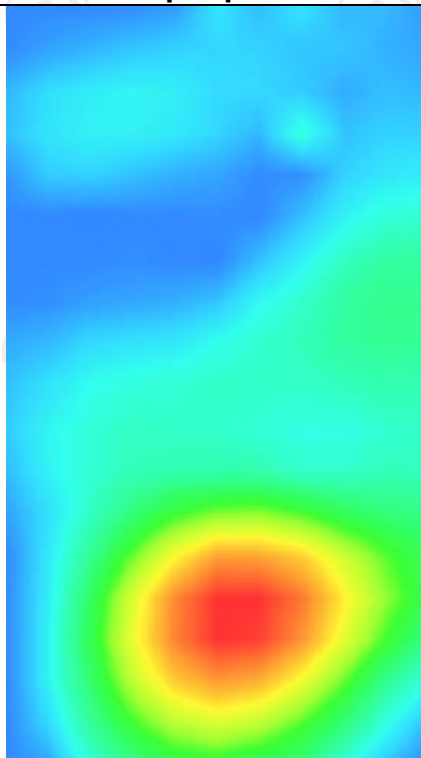
0.330210



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.6016	0.3528	0.1674	0.0728	0.0287



Hot spot position



LTE Band 17

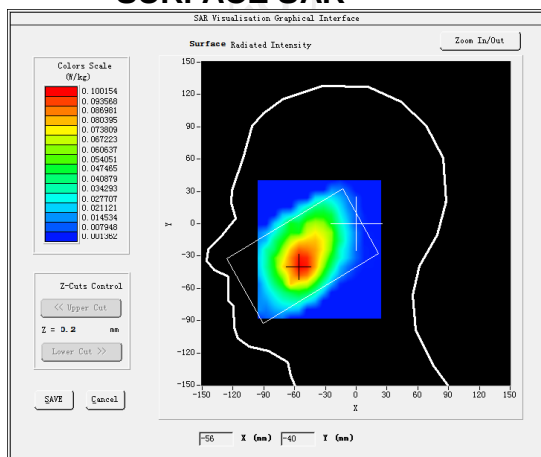
MEASUREMENT 1

Lower Band SAR (Channel 23755):

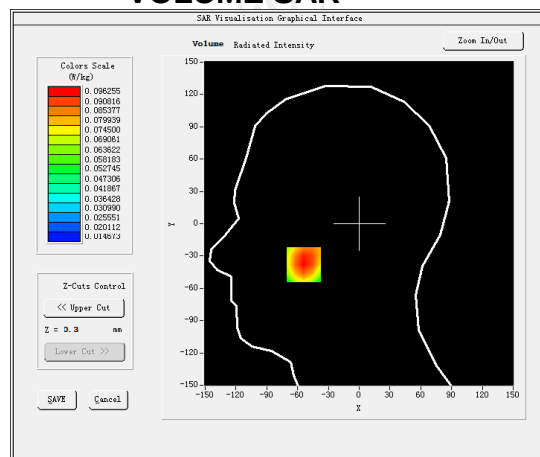
Date: 09/11/2019

Frequency (MHz)	706.500000
Relative permittivity (real part)	41.430182
Relative permittivity (imaginary part)	12.468765
Conductivity (S/m)	0.859210
Variation (%)	-1.049999
Crest Factor	1.0
Probe Conversion factor	4.38
E-Field Probe:	SSE5 (SN 07/15 EP248)
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>Right head</u>
Device Position	<u>Cheek</u>
Band	<u>LTE band 17(1 RB#13)</u>

SURFACE SAR



VOLUME SAR



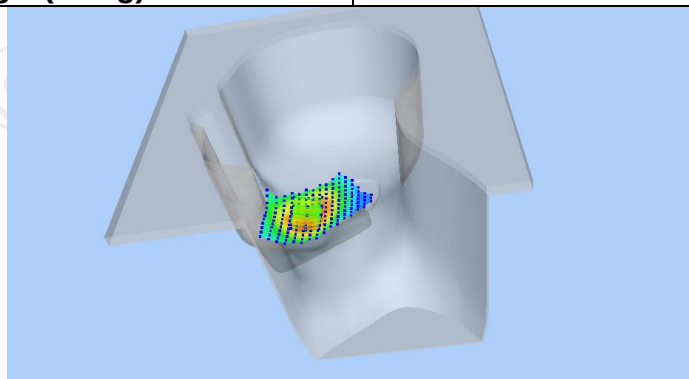
Maximum location: X=-54.00, Y=-38.00 SAR Peak: 0.11 W/kg

SAR 10g (W/Kg)

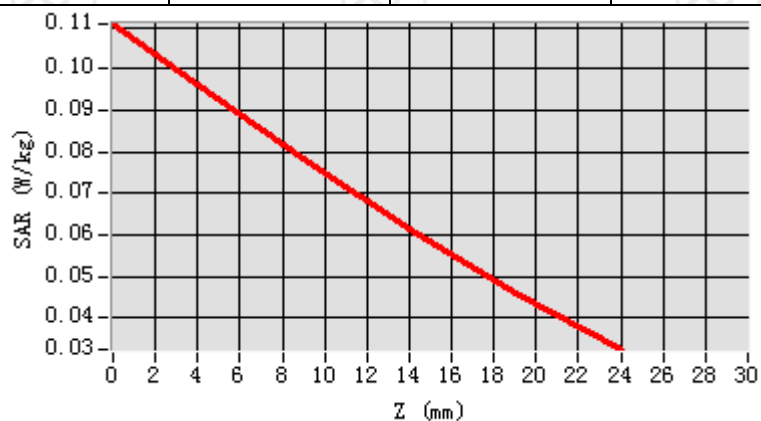
0.070160

SAR 1g (W/Kg)

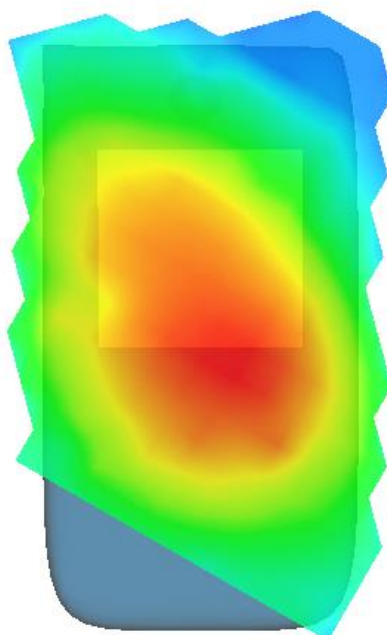
0.094565



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.1109	0.0963	0.0785	0.0616	0.0460



Hot spot position



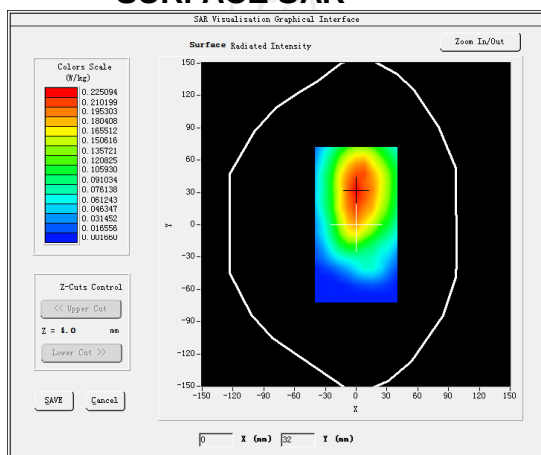
MEASUREMENT 2

Lower Band SAR (Channel 23755):

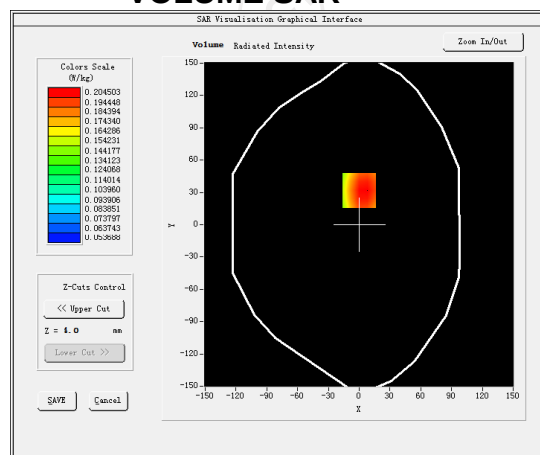
Date: 09/11/2019

Frequency (MHz)	706.500000
Relative permittivity (real part)	55.263812
Relative permittivity (imaginary part)	12.468867
Conductivity (S/m)	0.930822
Variation (%)	-1.360000
Crest Factor	1.0
Probe Conversion factor	4.52
E-Field Probe:	SSE5 (SN 07/15 EP248)
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(10mm)</u>
Band	<u>LTE band 17(1 RB#13)</u>

SURFACE SAR



VOLUME SAR



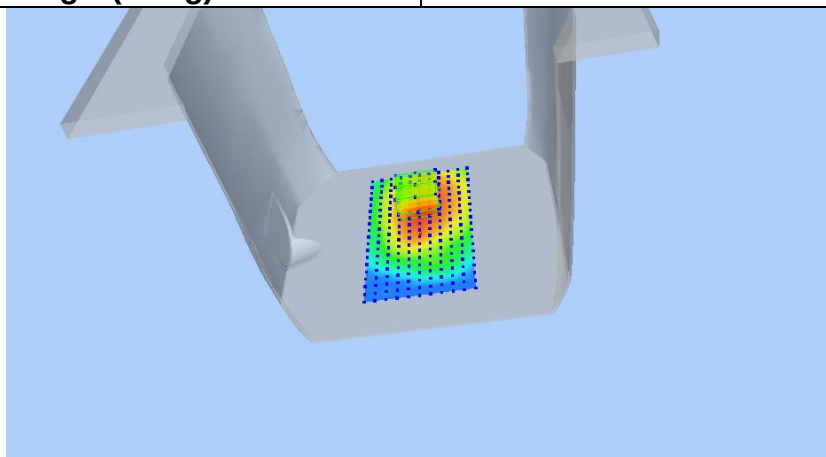
Maximum location: X=0.00, Y=32.00 SAR Peak: 0.23 W/kg

SAR 10g (W/Kg)

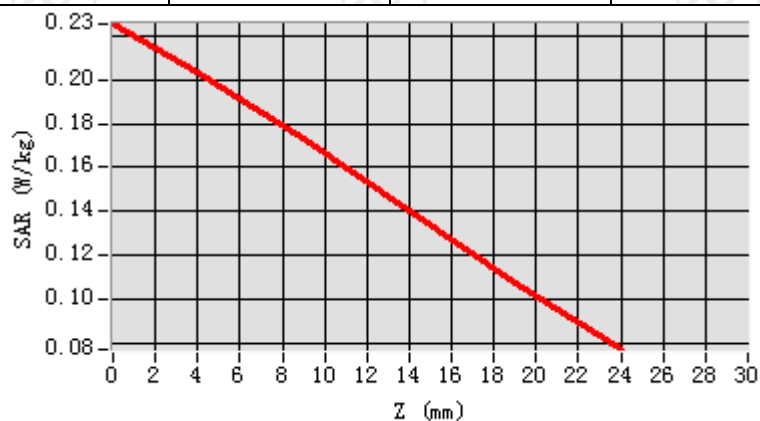
0.163761

SAR 1g (W/Kg)

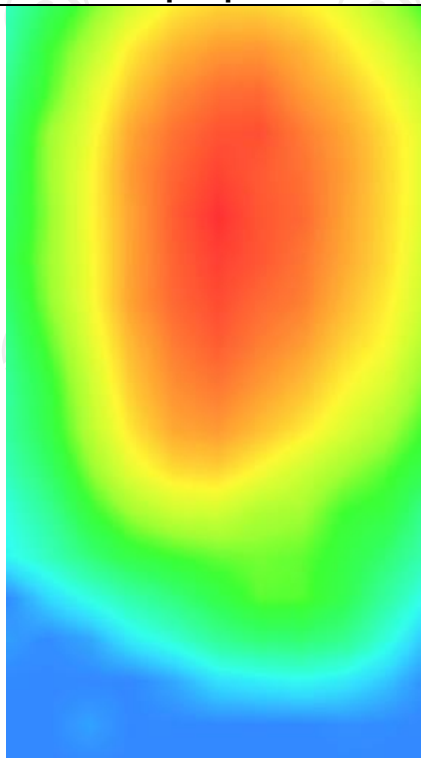
0.211528



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.2255	0.2037	0.1731	0.1402	0.1071



Hot spot position



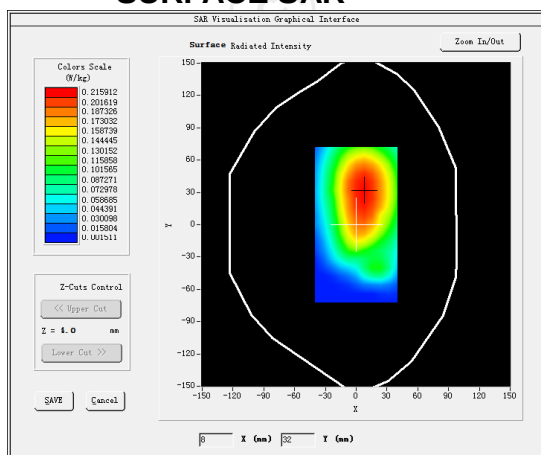
MEASUREMENT 3

Lower Band SAR (Channel 23755):

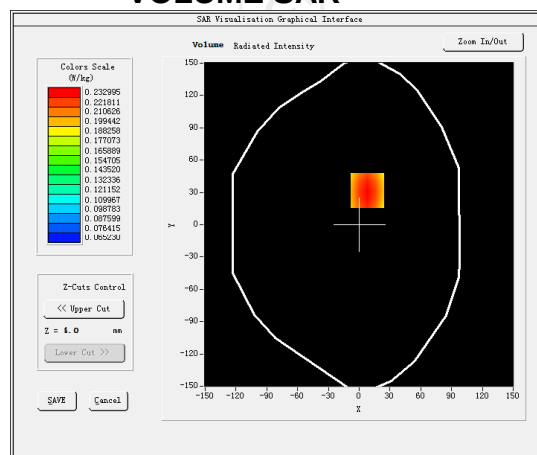
Date: 09/13/2019

Frequency (MHz)	706.500000
Relative permittivity (real part)	55.263812
Relative permittivity (imaginary part)	12.468867
Conductivity (S/m)	0.881392
Variation (%)	3.610000
Crest Factor	1.0
Probe Conversion factor	4.52
E-Field Probe:	SSE5 (SN 07/15 EP248)
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 17(1 RB#13)</u>

SURFACE SAR



VOLUME SAR



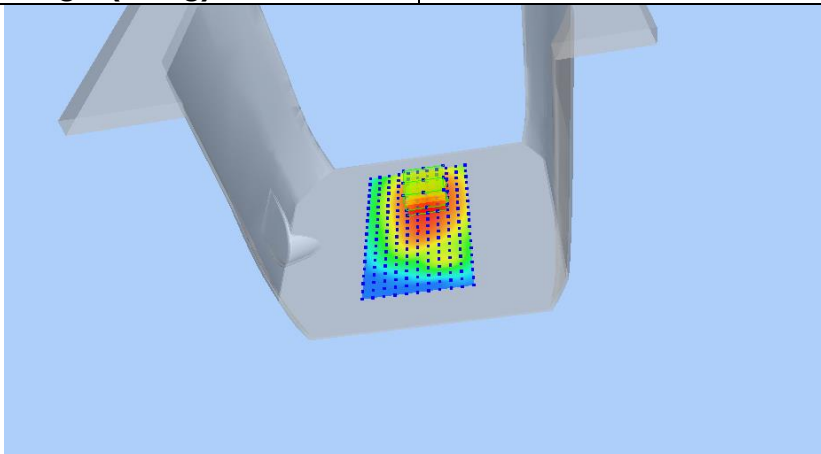
Maximum location: X=8.00, Y=32.00 SAR Peak: 0.29 W/kg

SAR 10g (W/Kg)

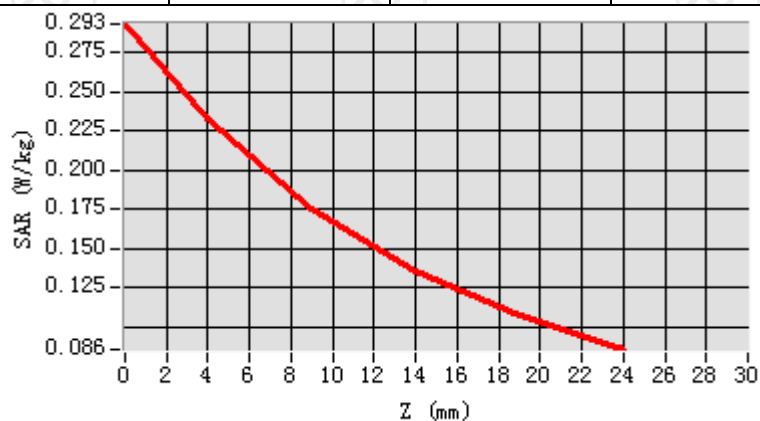
0.174627

SAR 1g (W/Kg)

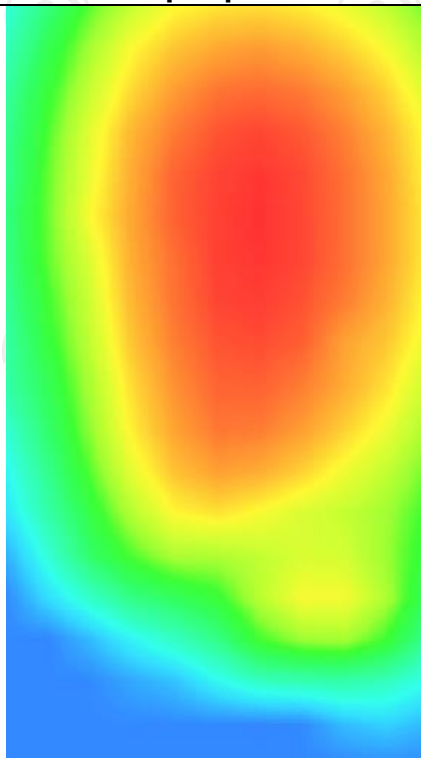
0.238358



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.2934	0.2330	0.1761	0.1359	0.1077



Hot spot position

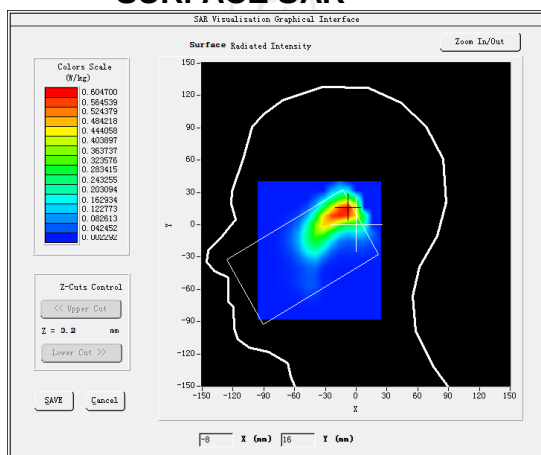


IEEE 802.11b

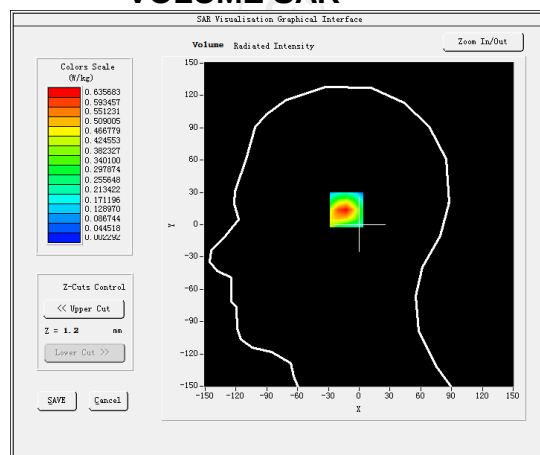
MEASUREMENT 1

Middle Band SAR (Channel 6):		Date: 09/20/2019
Frequency (MHz)	2437.000000	
Relative permittivity (real part)	37.851613	
Relative permittivity (imaginary part)	13.546980	
Conductivity (S/m)	1.814111	
Variation (%)	-1.470000	
Crest Factor	1.0	
Probe Conversion factor	4.58	
E-Field Probe:	SSE5 (SN 07/15 EP248)	
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	Left head	
Device Position	Cheek	
Band	IEEE 802.11b ISM	

SURFACE SAR



VOLUME SAR



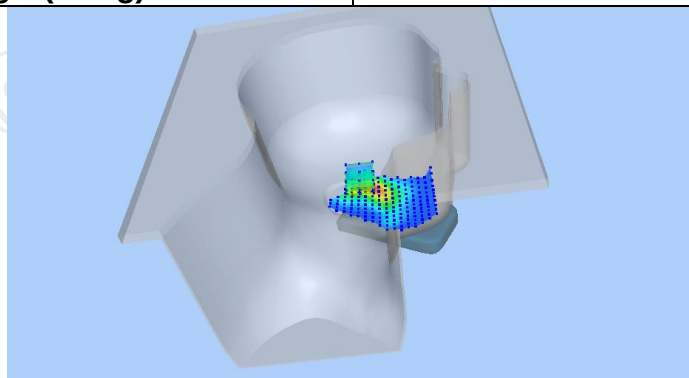
Maximum location: X=-10.00, Y=14.00 SAR Peak: 1.09 W/kg

SAR 10g (W/Kg)

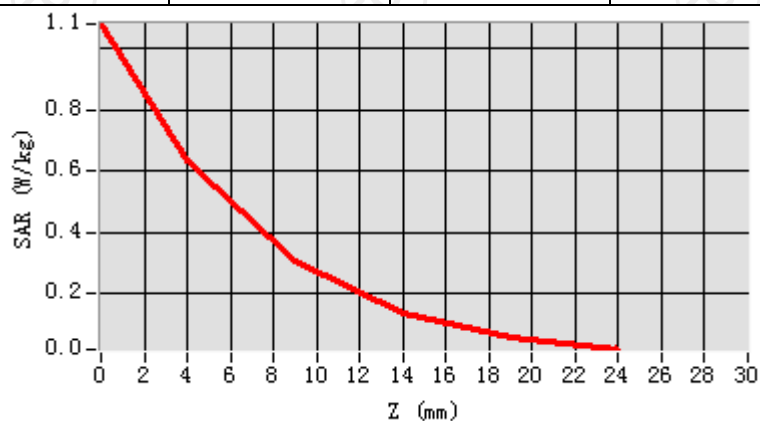
0.236709

SAR 1g (W/Kg)

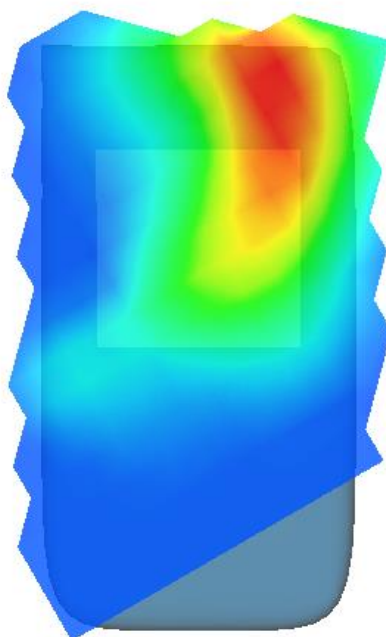
0.409922



Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	1.0812	0.6357	0.3037	0.1341	0.0546



Hot spot position



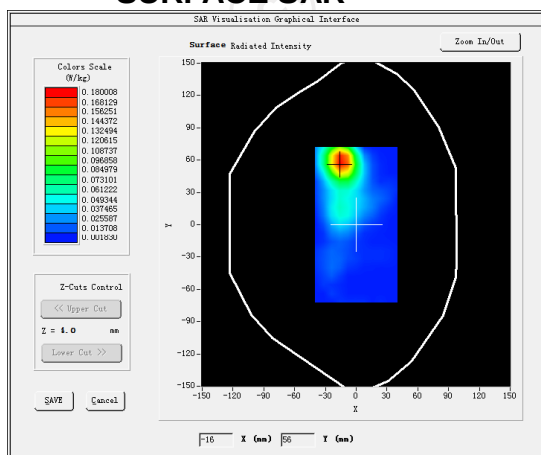
MEASUREMENT 2

Middle Band SAR (Channel 6):

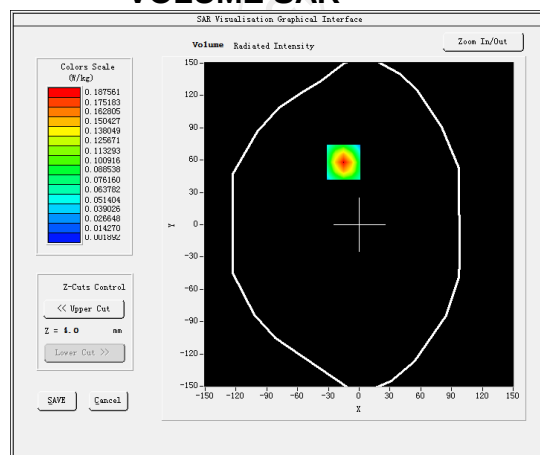
Date: 09/20/2019

Frequency (MHz)	2437.000000
Relative permittivity (real part)	54.630667
Relative permittivity (imaginary part)	14.318444
Conductivity (S/m)	1.982536
Variation (%)	4.010000
Crest Factor	1.0
Probe Conversion factor	4.70
E-Field Probe:	SSE5 (SN 07/15 EP248)
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(10mm)
Band	<u>IEEE 802.11b ISM</u>

SURFACE SAR



VOLUME SAR



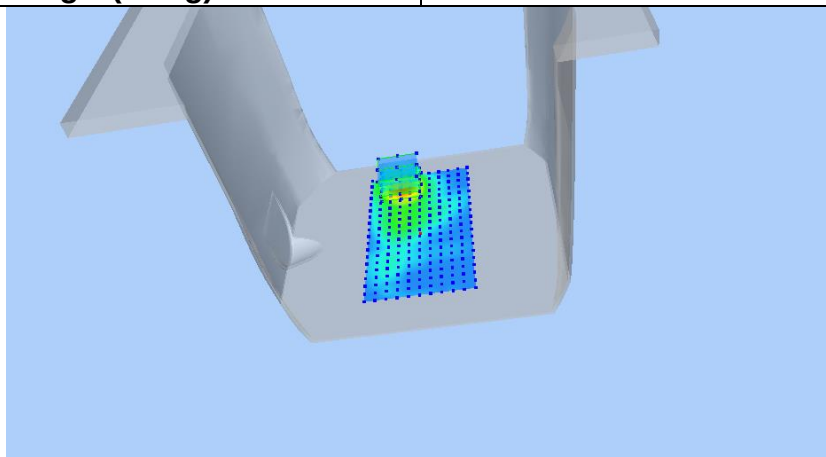
Maximum location: X=-15.00, Y=58.00 SAR Peak: 0.34 W/kg

SAR 10g (W/Kg)

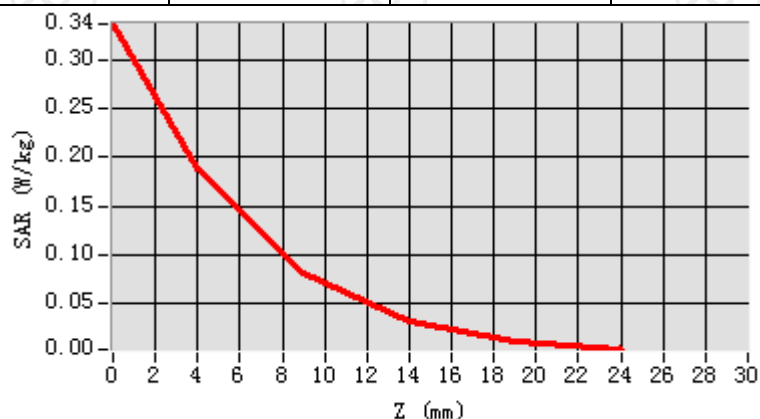
0.077530

SAR 1g (W/Kg)

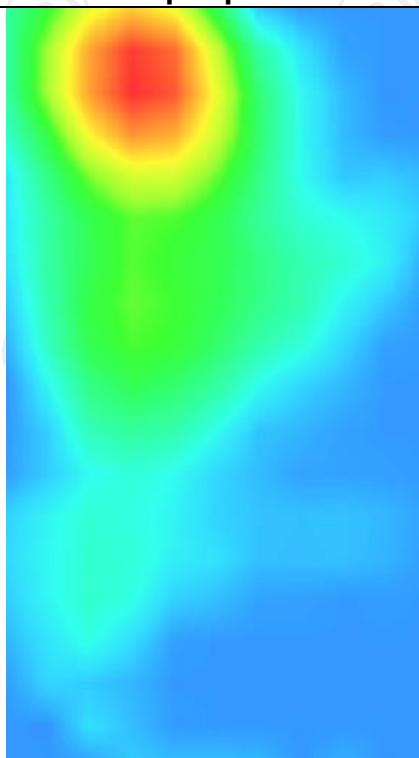
0.173292



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



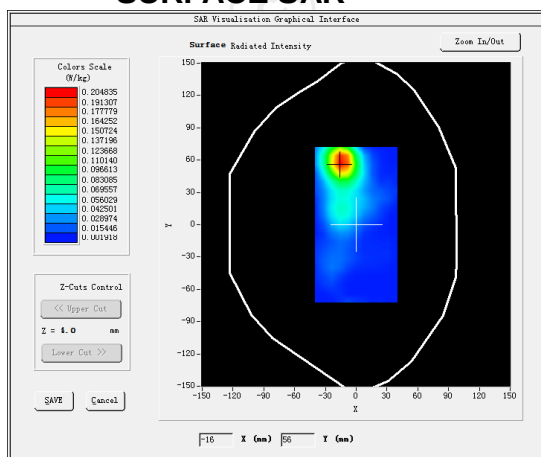
MEASUREMENT 3

Middle Band SAR (Channel 6):

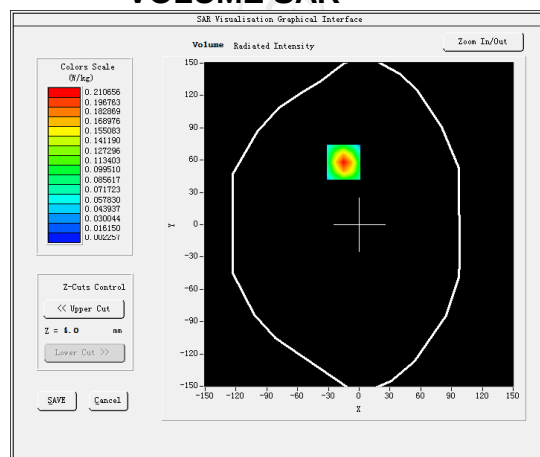
Date: 09/20/2019

Frequency (MHz)	2437.000000
Relative permittivity (real part)	54.630667
Relative permittivity (imaginary part)	14.318444
Conductivity (S/m)	1.982536
Variation (%)	-4.110000
Crest Factor	1.0
Probe Conversion factor	4.70
E-Field Probe:	SSE5 (SN 07/15 EP248)
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(10mm)
Band	<u>IEEE 802.11b ISM(hotspot)</u>

SURFACE SAR



VOLUME SAR



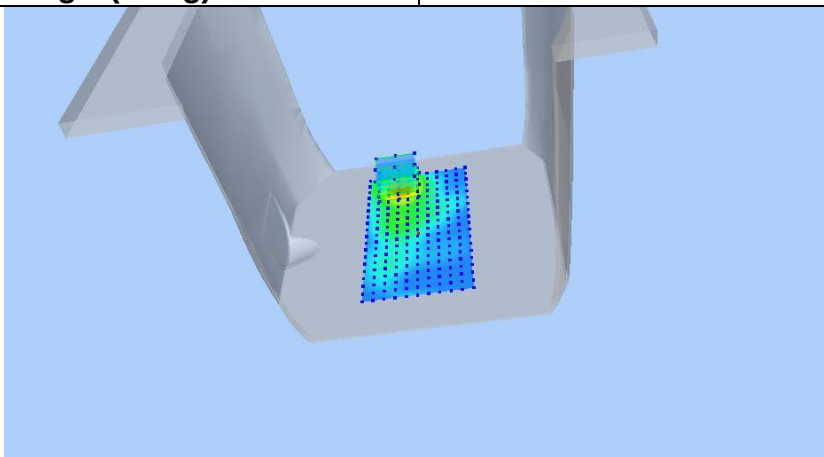
Maximum location: X=-15.00, Y=58.00 SAR Peak: 0.37 W/kg

SAR 10g (W/Kg)

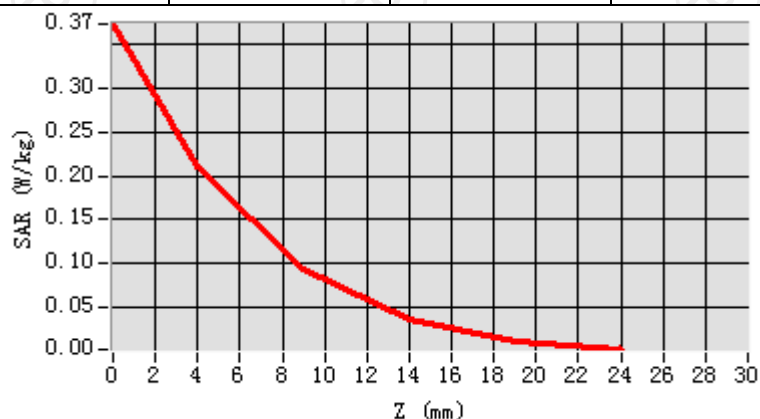
0.087182

SAR 1g (W/Kg)

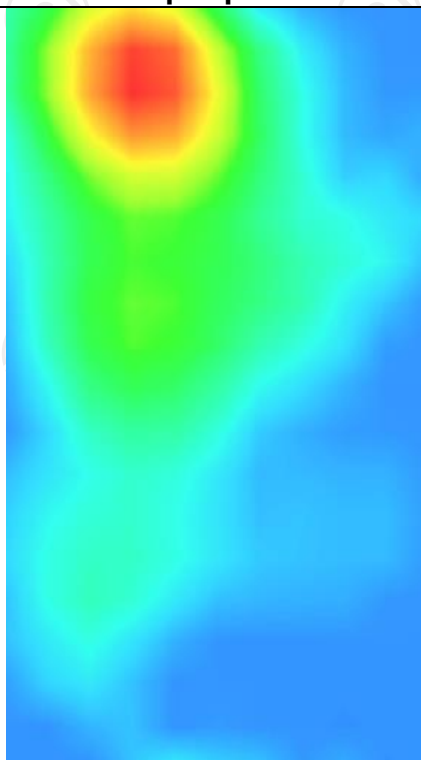
0.193788



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



Appendix A: EUT Photos



Liquid depth



The Body Liquid of 835MHz (15.4cm)



The Body Liquid of 1800MHz (15.2 cm)



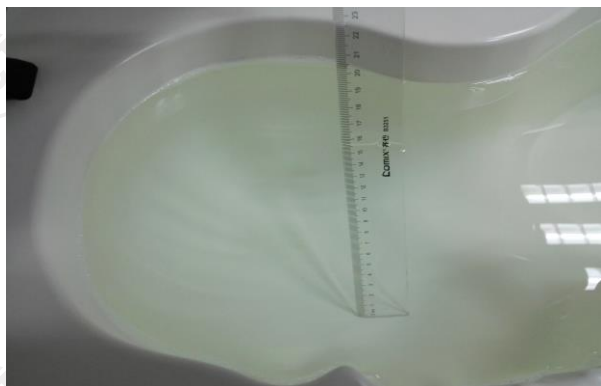
The Body Liquid of 1900MHz (16.4 cm)



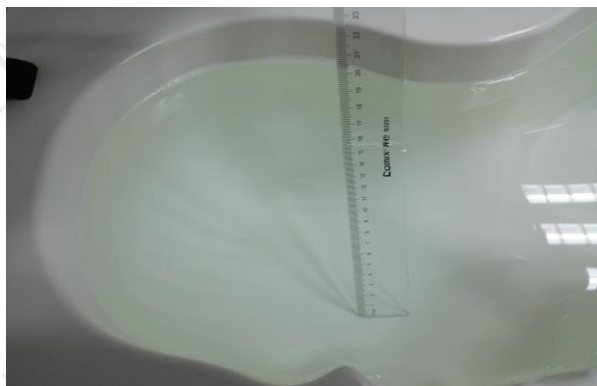
The Body Liquid of 2450MHz (15.3cm)



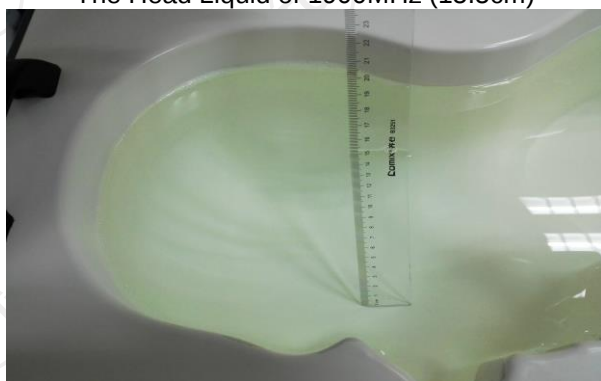
The Body Liquid of 2600MHz (16.5cm)



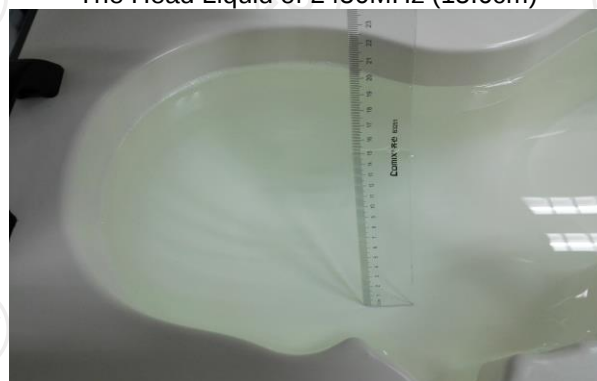
The Head Liquid of 1900MHz (15.5cm)



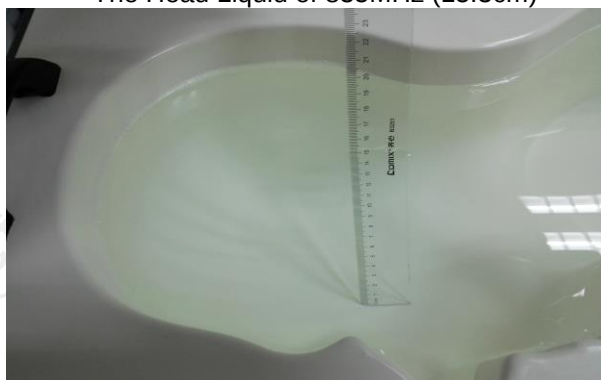
The Head Liquid of 2450MHz (15.6cm)



The Head Liquid of 835MHz (15.3cm)

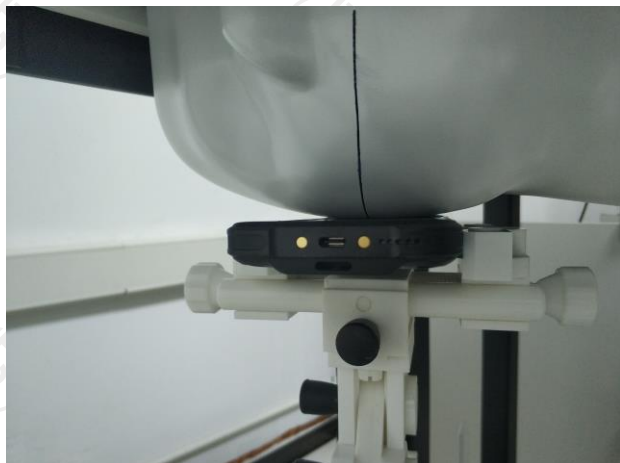


The Head Liquid of 2600MHz (15.1cm)

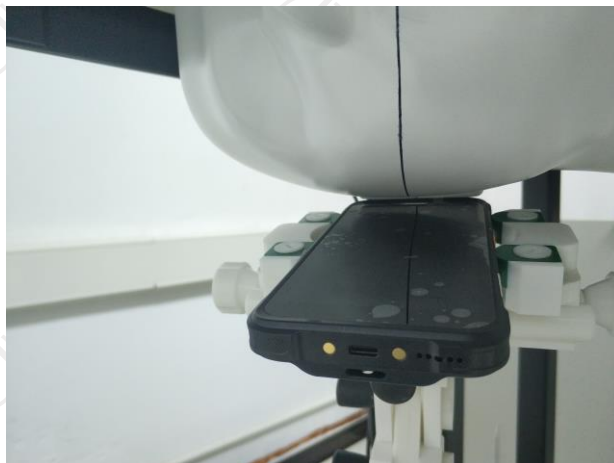


The Head Liquid of 1800MHz (15.2cm)

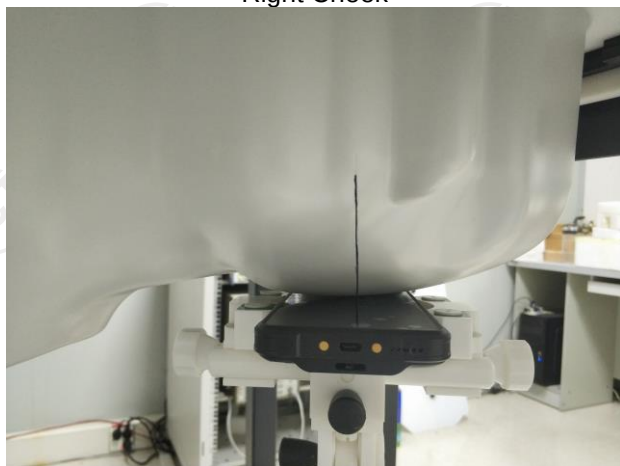
Appendix B: Test Setup Photos



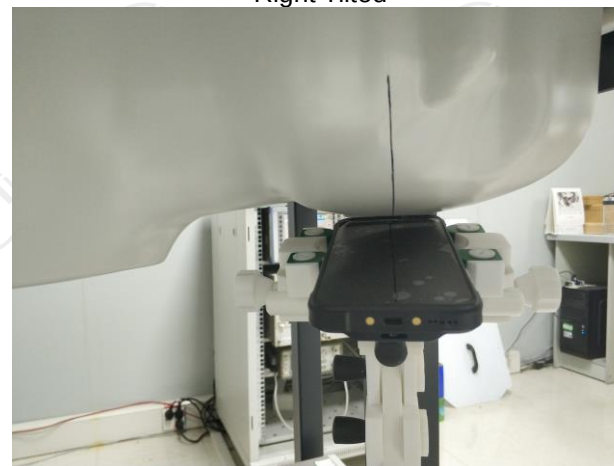
Right Cheek



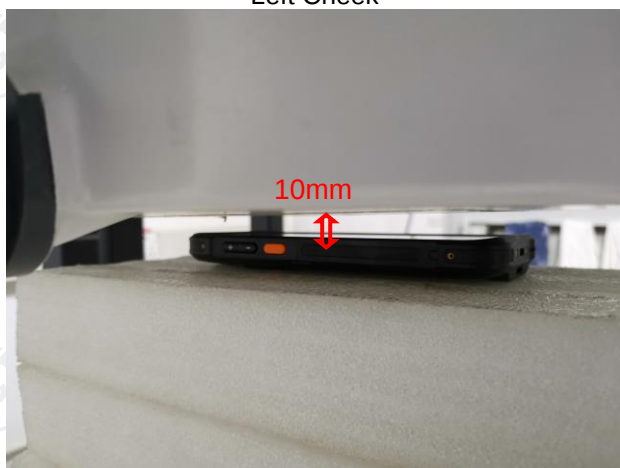
Right Tilted



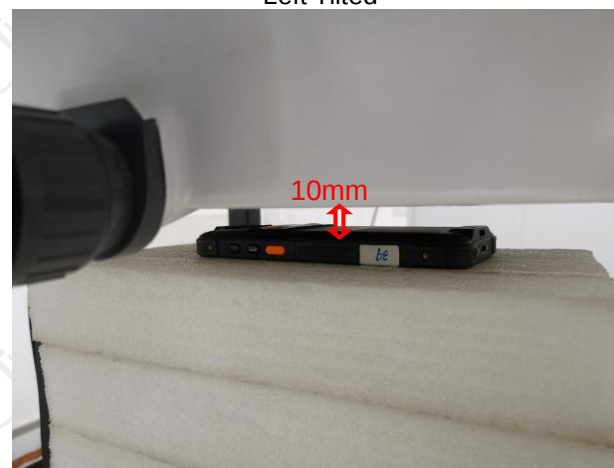
Left Cheek



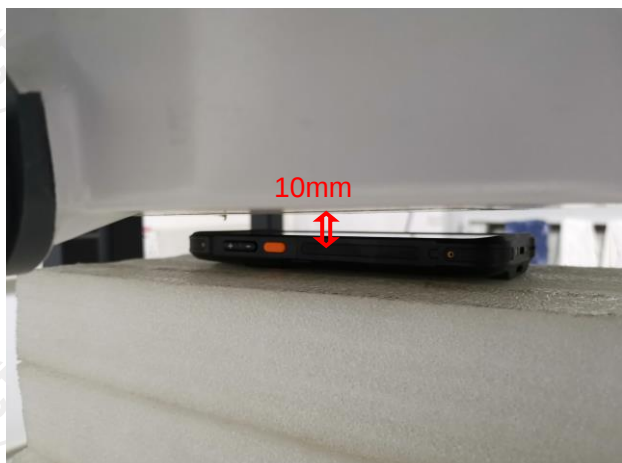
Left Tilted



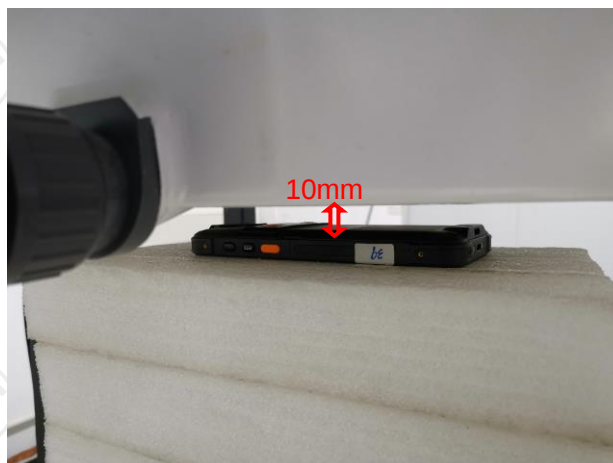
Body worn – Front (10mm)



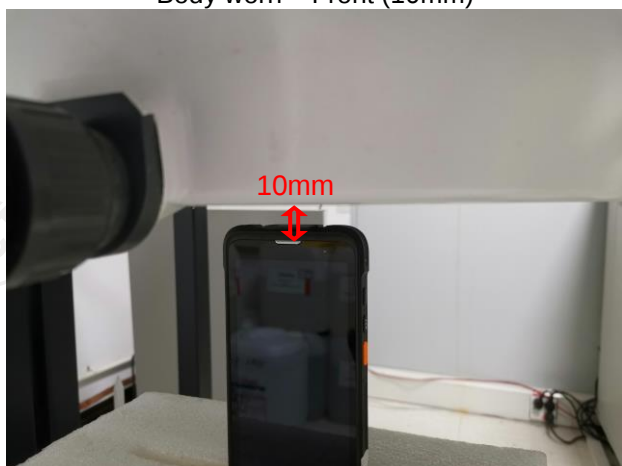
Body worn – Back (10mm)



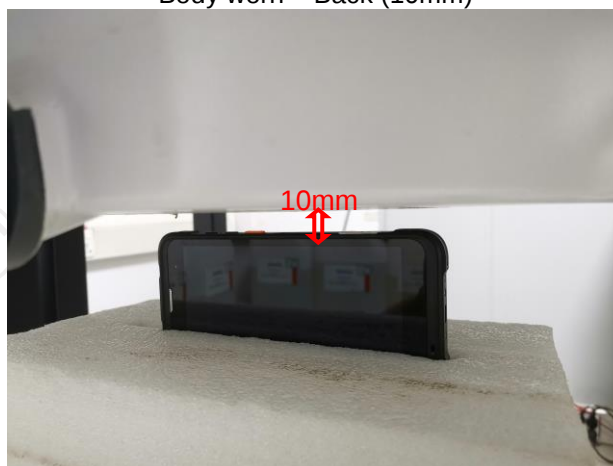
Body worn – Front (10mm)



Body worn – Back (10mm)



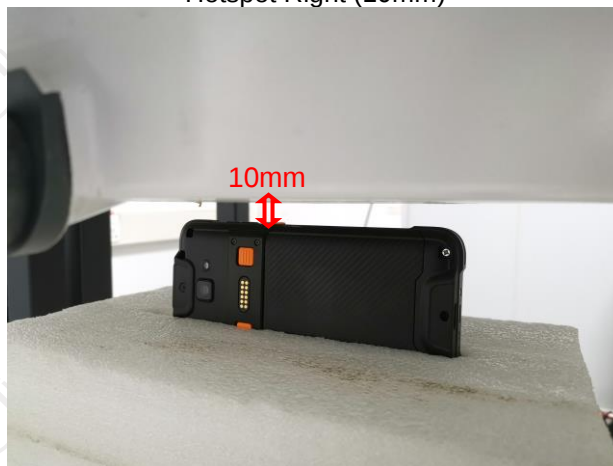
Hotspot Top (10mm)



Hotspot Right (10mm)



Hotspot Bottom (10mm)



Hotspot Left (10mm)

Appendix C: Probe Calibration Certificate

COMOSAR E-FIELD Probe



COMOSAR E-Field Probe Calibration Report

Ref : ACR.121.4.19.SATU.A

Shenzhen Tongce Testing Lab.
1B/F., Building 1, Yibaolai Industrial Park,
Qiaotou, Fuyong, Baoan District, Shenzhen, Guangdong, China
MVG COMOSAR DOSIMETRIC E-FIELD PROBE
SERIAL NO.: SN 07/15 EP248

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



Calibration Date: 01/09/2019

Summary:

This document presents the method and results from an accredited COMOSAR Dosimetric E-Field Probe calibration performed in MVG USA using the CALISAR / CALIBAIR test bench, for use with a COMOSAR system only. All calibration results are traceable to national metrology institutions.



COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.121.4.19.SATU.A

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	1/09/2019	<i>JS</i>
Checked by :	Jérôme LUC	Product Manager	1/09/2019	<i>JS</i>
Approved by :	Kim RUTKOWSKI	Quality Manager	1/09/2019	<i>Kim Rutkowski</i>

	Customer Name
Distribution :	Shenzhen Tongce Testing Lab

Issue	Date	Modifications
A	1/09/2019	Initial release

Page: 2/9

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COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.121.4.19.SATU.A

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	5
3.3	Lower Detection Limit	5
3.4	Isotropy	5
3.5	Boundary Effect	5
4	Measurement Uncertainty	5
5	Calibration Measurement Results	6
5.1	Sensitivity in air	6
5.2	Linearity	7
5.3	Sensitivity in liquid	7
5.4	Isotropy	8
6	List of Equipment	9

Page: 3/9

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COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.121.4.19.SATU.A

1 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR DOSIMETRIC E FIELD PROBE
Manufacturer	MVG
Model	SSE5
Serial Number	SN 07/15 EP248
Product Condition (new / used)	Used
Frequency Range of Probe	0.7 GHz-3GHz
Resistance of Three Dipoles at Connector	Dipole 1: R1=0.218 MΩ Dipole 2: R2=0.217 MΩ Dipole 3: R3=0.215 MΩ

A yearly calibration interval is recommended.

2 PRODUCT DESCRIPTION**2.1 GENERAL INFORMATION**

MVG's COMOSAR E field Probes are built in accordance to the IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209 standards.



Figure 1 – MVG COMOSAR Dosimetric E field Dipole

Probe Length	330 mm
Length of Individual Dipoles	4.5 mm
Maximum external diameter	8 mm
Probe Tip External Diameter	5 mm
Distance between dipoles / probe extremity	2.7 mm

3 MEASUREMENT METHOD

The IEEE 1528, OET 65 Bulletin C, CENELEC EN50361 and CEI/IEC 62209 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.

Page: 4/9

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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.

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 - 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°).

3.5 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.

4 MEASUREMENT UNCERTAINTY

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 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 (%)
Incident or forward power	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Reflected power	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Liquid conductivity	5.00%	Rectangular	$\sqrt{3}$	1	2.887%
Liquid permittivity	4.00%	Rectangular	$\sqrt{3}$	1	2.309%
Field homogeneity	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Field probe positioning	5.00%	Rectangular	$\sqrt{3}$	1	2.887%

Page: 5/9

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COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.121.4.19.SATU.A

Field probe linearity	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Combined standard uncertainty					5.831%
Expanded uncertainty 95 % confidence level k = 2					12.0%

5 CALIBRATION MEASUREMENT RESULTS

Calibration Parameters	
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

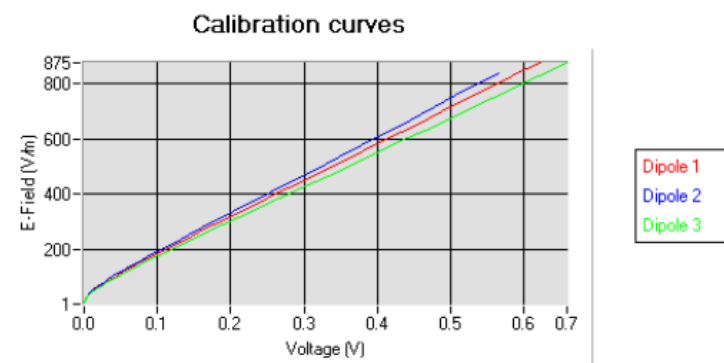
5.1 SENSITIVITY IN AIR

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 ($\mu\text{V}/(\text{V}/\text{m})^2$)
6.90	7.45	6.47

DCP dipole 1 (mV)	DCP dipole 2 (mV)	DCP dipole 3 (mV)
98	94	95

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

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



Page: 6/9

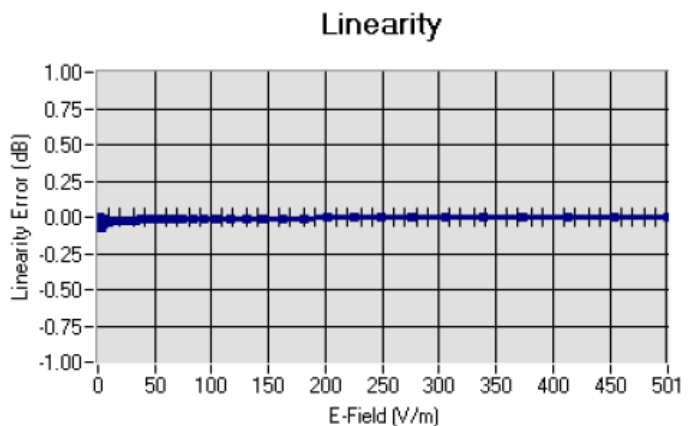
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COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.121.4.19.SATU.A

5.2 LINEARITY



Linearity: $\pm 1.58\%$ ($\pm 0.07\text{dB}$)

5.3 SENSITIVITY IN LIQUID

Liquid	Frequency (MHz $\pm$ 100MHz)	Permittivity	Epsilon (S/m)	ConvF
HL450	450	42.17	0.87	5.33
BL450	450	57.65	0.94	5.51
HL750	750	40.03	0.93	4.74
BL750	750	56.83	1.00	4.93
HL850	835	42.19	0.90	5.50
BL850	835	54.67	1.01	5.65
HL900	900	42.08	1.01	4.93
BL900	900	55.25	1.08	5.04
HL1800	1800	41.68	1.46	4.38
BL1800	1800	53.86	1.46	4.52
HL1900	1900	38.45	1.45	4.85
BL1900	1900	53.32	1.56	5.01
HL2000	2000	38.26	1.38	4.68
BL2000	2000	52.70	1.51	4.80
HL2450	2450	37.50	1.80	4.58
BL2450	2450	53.22	1.89	4.70
HL2600	2600	39.80	1.99	4.36
BL2600	2600	52.52	2.23	4.50

LOWER DETECTION LIMIT: 8mW/kg

Page: 7/9

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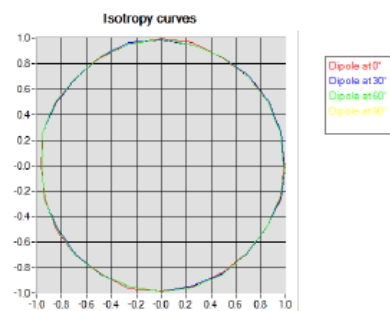
COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.121.4.19.SATU.A

5.4 ISOTROPY

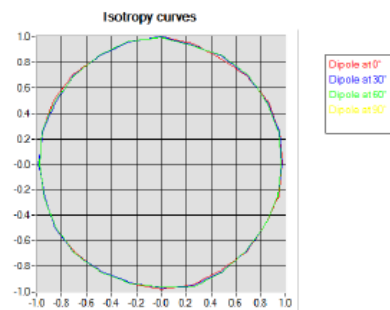
HL900 MHz

- Axial isotropy: 0.05 dB
- Hemispherical isotropy: 0.07 dB



HL1800 MHz

- Axial isotropy: 0.04 dB
- Hemispherical isotropy: 0.05 dB



Page: 8/9

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COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.121.4.19.SATU.A

6 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	Manufacturer / Model	Identification No.	Current Calibration Date	Next Calibration Date
Flat Phantom	MVG	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	02/2018	02/2021
Reference Probe	MVG	EP 94 SN 37/08	09/2018	02/2019
Multimeter	Keithley 2000	1188656	11/2016	11/2019
Signal Generator	Agilent E4438C	MY49070581	02/2018	02/2021
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	11/2016	11/2019
Power Sensor	HP ECP-E26A	US37181460	11/2016	11/2019
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Waveguide	Mega Industries	069Y7-158-13-712	Validated. No cal required.	Validated. No cal required.
Waveguide Transition	Mega Industries	069Y7-158-13-701	Validated. No cal required.	Validated. No cal required.
Waveguide Termination	Mega Industries	069Y7-158-13-701	Validated. No cal required.	Validated. No cal required.
Temperature / Humidity Sensor	Control Company	11-661-9	10/2018	10/2019

Page: 9/9

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Dielectric Probe Calibration Report

Ref : ACR.138.4.33.SATU.A

Shenzhen Tongce Testing Lab.

1B/F., Building 1, Yibaolai Industrial Park,
Qiaotou, Fuyong, Baoan District, Shenzhen, Guangdong, 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: 06/05/2018

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..SATU.A

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	06/05/2018	<i>JS</i>
Checked by :	Jérôme LUC	Product Manager	06/05/2018	<i>JS</i>
Approved by :	Kim RUTKOWSKI	Quality Manager	06/05/2018	<i>Kim Rutkowski</i>

	Customer Name
Distribution :	Shenzhen Tongce Testing Lab

Issue	Date	Modifications
A	06/05/2018	Initial release

Page: 2/7

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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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SAR DIELECTRIC PROBE CALIBRATION REPORT

Ref: ACR.138.4.33..SATU.A

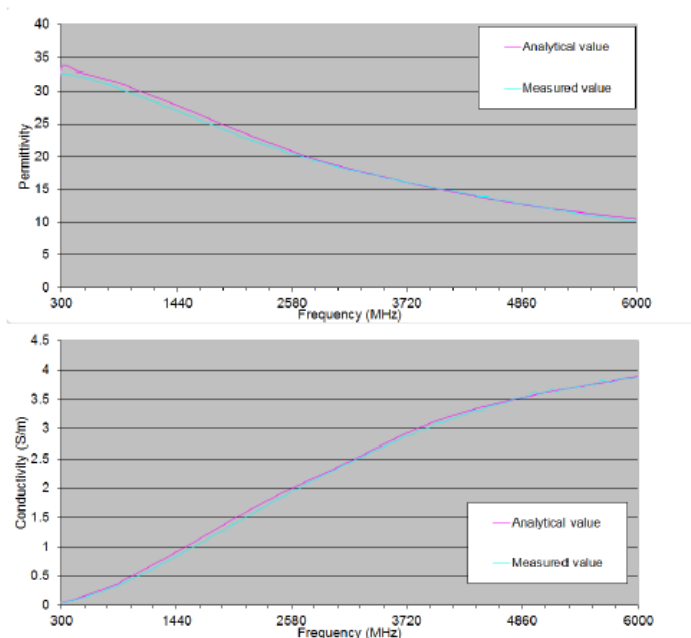
6 CALIBRATION MEASUREMENT RESULTS

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: ACR.138.4.33..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	02/2018	02/2021
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	09/2018	09/2019

Page: 7/7

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Appendix D: Dipole Calibration Report

SID 835



SAR Reference Dipole Calibration Report

Ref : ACR.156.4.15.SATU.A

SHENZHEN TONGCE TESTING Lab.

1B/F., Building 1, Yibaolai Industrial Park,
Qiaotou, Fuyong, Baoan District, Shenzhen, Guangdong, China

MVG COMOSAR REFERENCE DIPOLE

FREQUENCY: 835 MHZ

SERIAL NO.: SN 16/15 DIP 0G835-369

Calibrated at MVG US

2105 Barrett Park Dr. - Kennesaw, GA 30144



Calibration Date: 06/05/2018

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.156.4.15.SATU.A

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	06/05/2018	<i>JS</i>
Checked by :	Jérôme LUC	Product Manager	06/05/2018	<i>JS</i>
Approved by :	Kim RUTKOWSKI	Quality Manager	06/05/2018	<i>Kim Rutkowski</i>

	Customer Name
Distribution :	Shenzhen Tongce Testing Lab

Issue	Date	Modifications
A	06/05/2018	Initial release

Page: 2/11

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.4.15.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	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

Page: 3/11

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.4.15.SATU.A

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 835 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID835
Serial Number	SN 16/15 DIP 0G835-369
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

Page: 4/11

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.4.15.SATU.A

4 MEASUREMENT METHOD

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

4.1 RETURN LOSS REQUIREMENTS

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

4.2 MECHANICAL REQUIREMENTS

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

5 MEASUREMENT UNCERTAINTY

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

5.1 RETURN LOSS

The following uncertainties apply to the return loss measurement:

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

5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

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

5.3 VALIDATION MEASUREMENT

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

Scan Volume	Expanded Uncertainty
1 g	20.3 %

Page: 5/11

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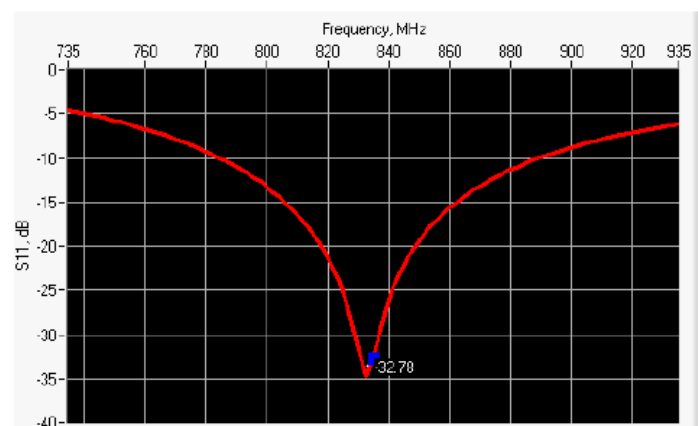
SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.4.15.SATU.A

10 g	20.1 %
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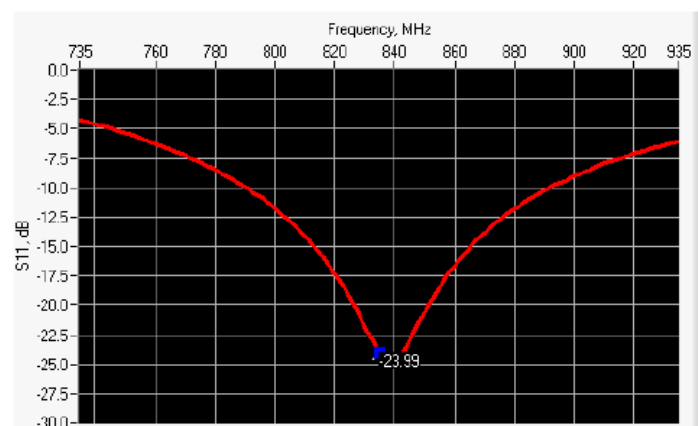
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
835	-32.78	-20	$51.5 \Omega + 1.7 j\Omega$

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
835	-23.99	-20	$47.3 \Omega + 5.6 j\Omega$

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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Ref: ACR.156.4.15.SATU.A

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

7 VALIDATION MEASUREMENT

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

7.1 HEAD LIQUID MEASUREMENT

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

Page: 7/11

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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}^* : 42.3 sigma : 0.92
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	835 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

Frequency MHz	1 g SAR (W/kg/W)		10 g SAR (W/kg/W)	
	required	measured	required	measured
300	2.85		1.94	
450	4.58		3.06	
750	8.49		5.55	
835	9.56	9.53 (0.82)	6.22	6.12 (0.58)
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

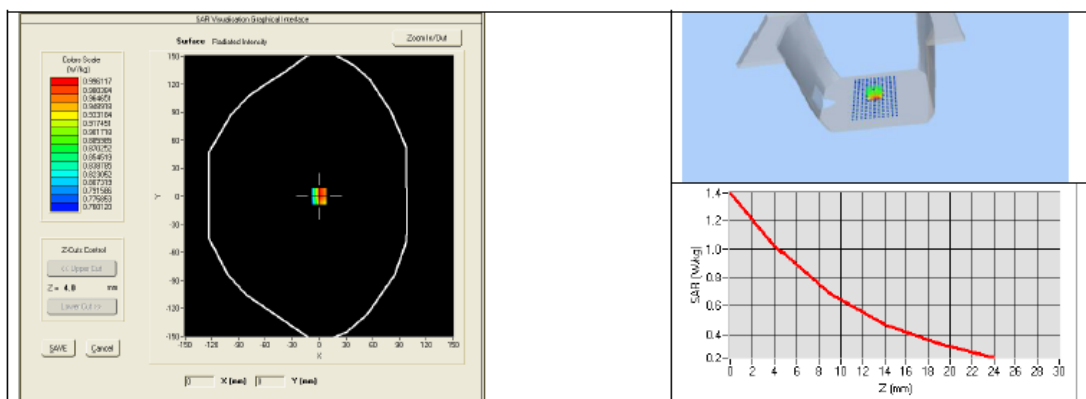
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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.4.15.SATU.A

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	



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 %		0.96 $\pm$ 5 %	
835	55.2 $\pm$ 5 %	PASS	0.97 $\pm$ 5 %	PASS
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 %	

Page: 9/11

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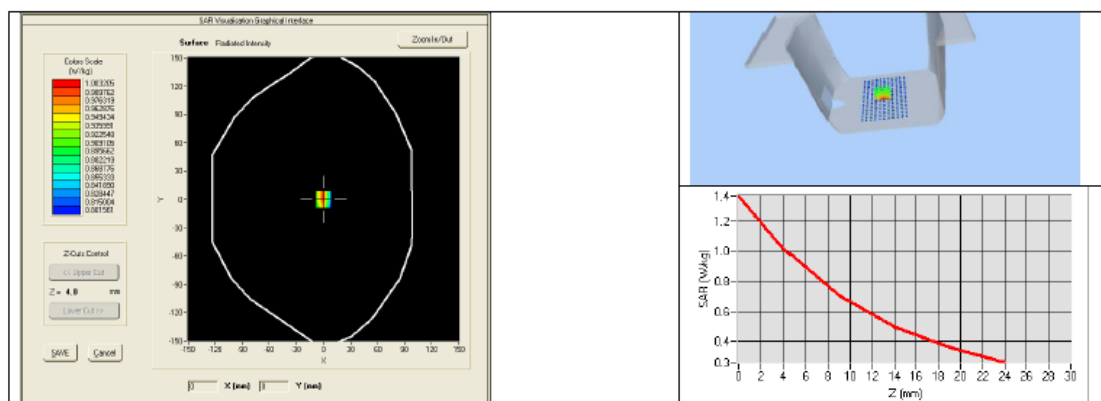
Ref: ACR.156.4.15.SATU.A

2600	52.5 ±5 %		2.16 ±5 %	
3000	52.0 ±5 %		2.73 ±5 %	
3500	51.3 ±5 %		3.31 ±5 %	
5200	49.0 ±10 %		5.30 ±10 %	
5300	48.9 ±10 %		5.42 ±10 %	
5400	48.7 ±10 %		5.53 ±10 %	
5500	48.6 ±10 %		5.65 ±10 %	
5600	48.5 ±10 %		5.77 ±10 %	
5800	48.2 ±10 %		6.00 ±10 %	

7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Body Liquid Values: ϵ_{ps}' : 53.3 σ : 0.97
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	835 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

Frequency MHz	1 g SAR (W/kg/W)	10 g SAR (W/kg/W)
	measured	measured
835	9.62 (0.91)	6.44 (0.59)



Page: 10/11

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.4.15.SATU.A

8 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	Manufacturer / Model	Identification No.	Current Calibration Date	Next Calibration Date
SAM Phantom	MVG	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	02/2018	02/2021
Calipers	Carrera	CALIPER-01	02/2018	02/2021
Reference Probe	MVG	EPG122 SN 18/11	02/2018	02/2019
Multimeter	Keithley 2000	1188656	02/2018	02/2021
Signal Generator	Agilent E4438C	MY49070581	02/2018	02/2021
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	02/2018	02/2021
Power Sensor	HP ECP-E26A	US37181460	02/2018	02/2021
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	02/2018	02/2021

Page: 11/11

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SAR Reference Dipole Calibration Report

Ref : ACR.156.6.15.SATU.A

SHENZHEN TONGCE TESTING Lab.

1B/F., Building 1, Yibaolai Industrial Park,
Qiaotou, Fuyong, Baoan District, Shenzhen, Guangdong, China

MVG COMOSAR REFERENCE DIPOLE

FREQUENCY: 1800 MHZ

SERIAL NO.: SN 16/15 DIP 1G800-371

Calibrated at MVG US

2105 Barrett Park Dr. - Kennesaw, GA 30144



Calibration Date: 06/05/2018

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.156.6.15.SATU.A

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	06/05/2018	<i>JS</i>
Checked by :	Jérôme LUC	Product Manager	06/05/2018	<i>JS</i>
Approved by :	Kim RUTKOWSKI	Quality Manager	06/05/2018	<i>Kim Rutkowski</i>

	Customer Name
Distribution :	Shenzhen Tongce Testing Lab

Issue	Date	Modifications
A	06/05/2018	Initial release

Page: 2/11

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.6.15.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	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

Page: 3/11

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.6.15.SATU.A

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 1800 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID1800
Serial Number	SN 16/15 DIP 1G800-371
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

Page: 4/11

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4 MEASUREMENT METHOD

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

4.1 RETURN LOSS REQUIREMENTS

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

4.2 MECHANICAL REQUIREMENTS

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

5 MEASUREMENT UNCERTAINTY

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

5.1 RETURN LOSS

The following uncertainties apply to the return loss measurement:

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

5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

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

5.3 VALIDATION MEASUREMENT

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

Scan Volume	Expanded Uncertainty
1 g	20.3 %

Page: 5/11

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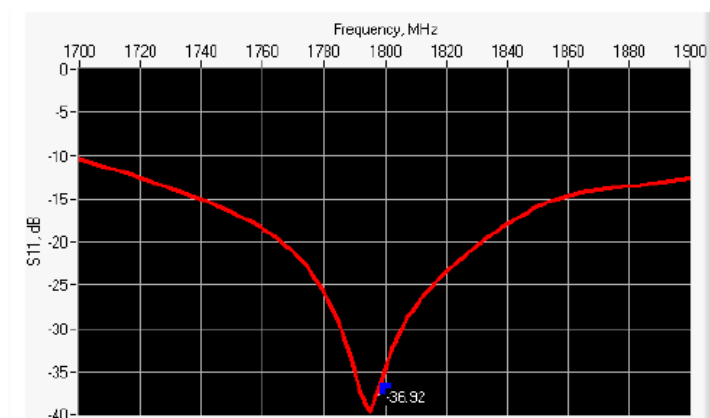
SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.6.15.SATU.A

10 g	20.1 %
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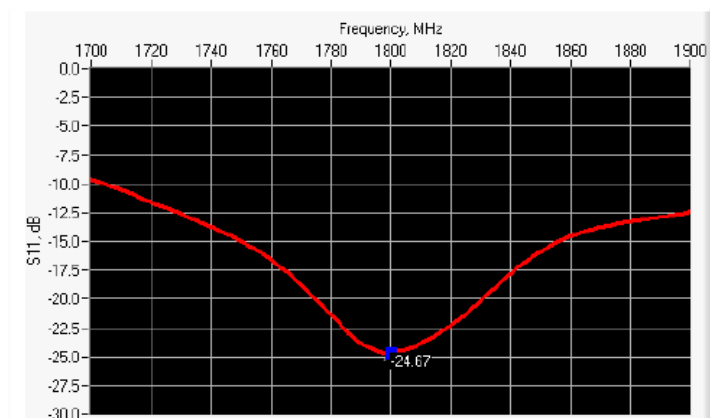
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
1800	-36.92	-20	48.3 Ω - 0.5 j Ω

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
1800	-24.67	-20	47.6 Ω - 5.1 j Ω

6.3 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 %	

Page: 6/11

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450	290.0 ±1 %.		166.7 ±1 %.		6.35 ±1 %.	
750	176.0 ±1 %.		100.0 ±1 %.		6.35 ±1 %.	
835	161.0 ±1 %.		89.8 ±1 %.		3.6 ±1 %.	
900	149.0 ±1 %.		83.3 ±1 %.		3.6 ±1 %.	
1450	89.1 ±1 %.		51.7 ±1 %.		3.6 ±1 %.	
1500	80.5 ±1 %.		50.0 ±1 %.		3.6 ±1 %.	
1640	79.0 ±1 %.		45.7 ±1 %.		3.6 ±1 %.	
1750	75.2 ±1 %.		42.9 ±1 %.		3.6 ±1 %.	
1800	72.0 ±1 %.	PASS	41.7 ±1 %.	PASS	3.6 ±1 %.	PASS
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 %		0.89 ±5 %	
835	41.5 ±5 %		0.90 ±5 %	
900	41.5 ±5 %		0.97 ±5 %	
1450	40.5 ±5 %		1.20 ±5 %	
1500	40.4 ±5 %		1.23 ±5 %	
1640	40.2 ±5 %		1.31 ±5 %	
1750	40.1 ±5 %		1.37 ±5 %	

Page: 7/11

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1800	40.0 ±5 %	PASS	1.40 ±5 %	PASS
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 sigma : 1.38
Distance between dipole center and liquid	10.0 mm
Area scan resolution	$dx=8mm/dy=8mm$
Zoon Scan Resolution	$dx=8mm/dy=8mm/dz=5mm$
Frequency	1800 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

Frequency MHz	1 g SAR (W/kg/W)		10 g SAR (W/kg/W)	
	required	measured	required	measured
300	2.85		1.94	
450	4.58		3.06	
750	8.49		5.55	
835	9.56		6.22	
900	10.9		6.99	
1450	29		16	
1500	30.5		16.8	
1640	34.2		18.4	
1750	36.4		19.3	
1800	38.4	37.67(3.60)	20.1	20.23 (2.15)

Page: 8/11

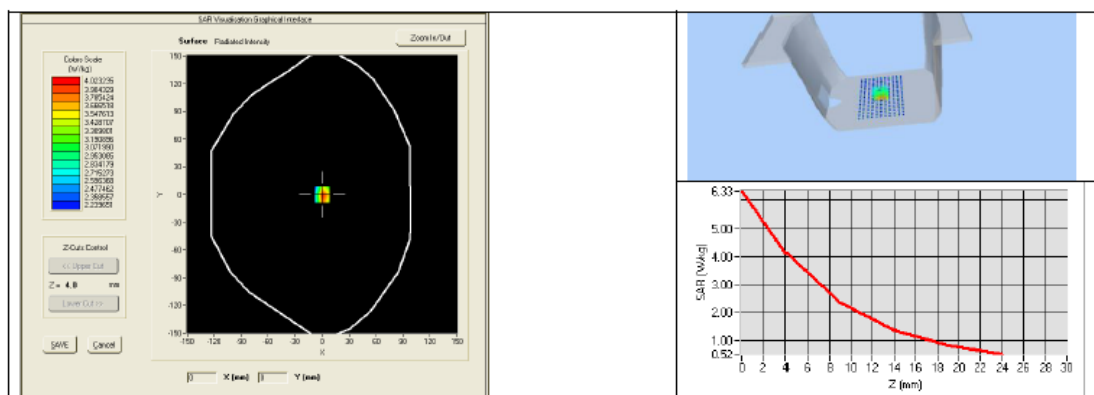
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1900	39.7		20.5	
1950	40.5		20.9	
2000	41.1		21.1	
2100	43.6		21.9	
2300	48.7		23.3	
2450	52.4		24	
2600	55.3		24.6	
3000	63.8		25.7	
3500	67.1		25	



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 %		0.96 $\pm$ 5 %	
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 %	PASS	1.52 $\pm$ 5 %	PASS
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 %	

Page: 9/11

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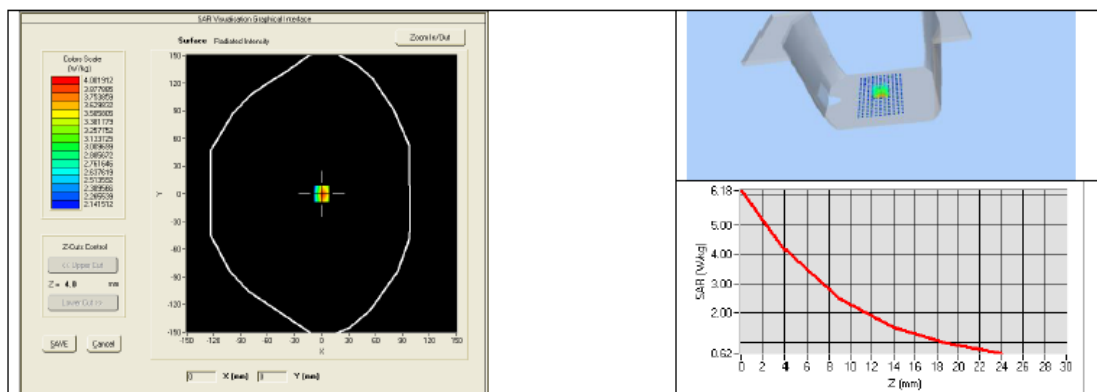
Ref: ACR.156.6.15.SATU.A

2600	52.5 ±5 %		2.16 ±5 %	
3000	52.0 ±5 %		2.73 ±5 %	
3500	51.3 ±5 %		3.31 ±5 %	
5200	49.0 ±10 %		5.30 ±10 %	
5300	48.9 ±10 %		5.42 ±10 %	
5400	48.7 ±10 %		5.53 ±10 %	
5500	48.6 ±10 %		5.65 ±10 %	
5600	48.5 ±10 %		5.77 ±10 %	
5800	48.2 ±10 %		6.00 ±10 %	

7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Body Liquid Values: eps' : 53.0 sigma : 1.52
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=8mm/dy=8mm/dz=5mm
Frequency	1800 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)
	measured	measured
1800	37.69 (3.65)	20.57 (2.00)



Page: 10/11

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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	MVG	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	02/2018	02/2021
Calipers	Carrera	CALIPER-01	02/2018	02/2021
Reference Probe	MVG	EPG122 SN 18/11	02/2018	02/2019
Multimeter	Keithley 2000	1188656	02/2018	02/2021
Signal Generator	Agilent E4438C	MY49070581	02/2018	02/2021
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	02/2018	02/2021
Power Sensor	HP ECP-E26A	US37181460	02/2018	02/2021
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	02/2018	02/2021

Page: 11/11

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SAR Reference Dipole Calibration Report

Ref : ACR.156.7.15.SATU.A

SHENZHEN TONGCE TESTING Lab.

1B/F., Building 1, Yibaolai Industrial Park,
Qiaotou, Fuyong, Baoan District, Shenzhen, Guangdong, China

MVG COMOSAR REFERENCE DIPOLE

FREQUENCY: 1900 MHZ

SERIAL NO.: SN 16/15 DIP 1G900-372

Calibrated at MVG US

2105 Barrett Park Dr. - Kennesaw, GA 30144



Calibration Date: 06/05/2018

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.156.7.15.SATU.A

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	06/05/2018	<i>JS</i>
Checked by :	Jérôme LUC	Product Manager	06/05/2018	<i>JS</i>
Approved by :	Kim RUTKOWSKI	Quality Manager	06/05/2018	<i>Kim Rutkowski</i>

	Customer Name
Distribution :	Shenzhen Tongce Testing Lab

Issue	Date	Modifications
A	06/05/2018	Initial release

Page: 2/11

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.7.15.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	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

Page: 3/11

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.156.7.15.SATU.A

1 INTRODUCTION

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

2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR 1900 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID1900
Serial Number	SN 16/15 DIP 1G900-372
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

Page: 4/11

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