

Appendix A: Plots of SAR System Check

System check at 750 MHz

Date of measurement: 22/12/2022

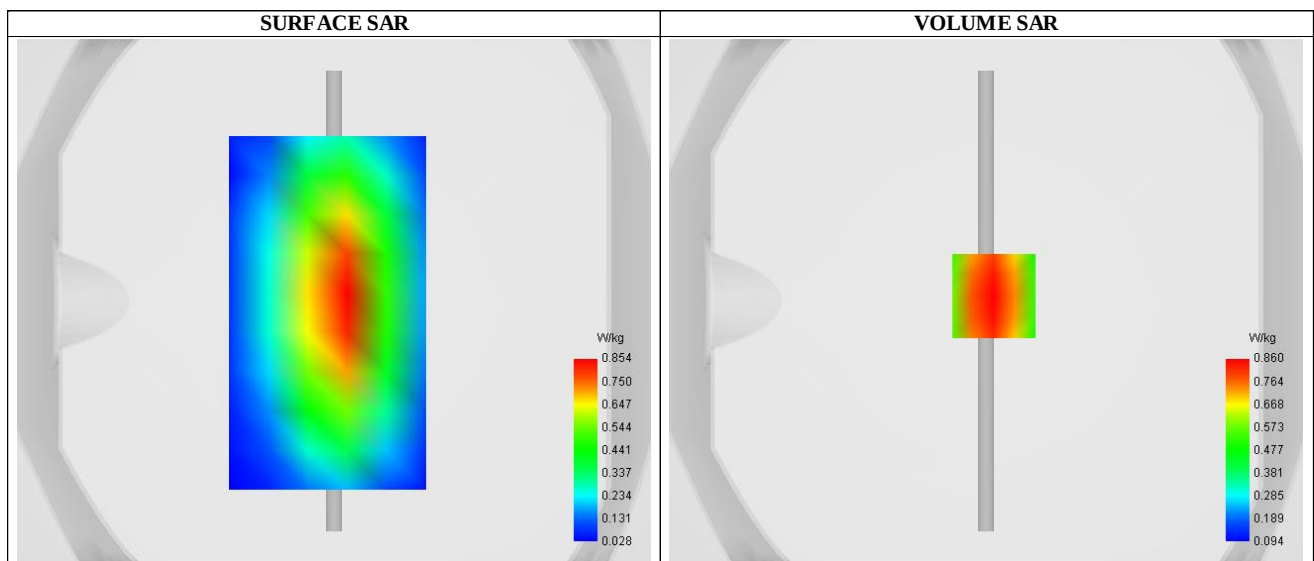
A. Experimental conditions.

Probe	SN 18/21 EPG0354
ConvF	1.70
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Dipole
Band	CW750
Channels	Middle
Signal	CW (Crest factor: 1.0)

B. Permittivity

Frequency (MHz)	750.000000
Relative permittivity (real part)	42.380000
Conductivity (S/m)	0.900000

C. SAR Surface and Volume

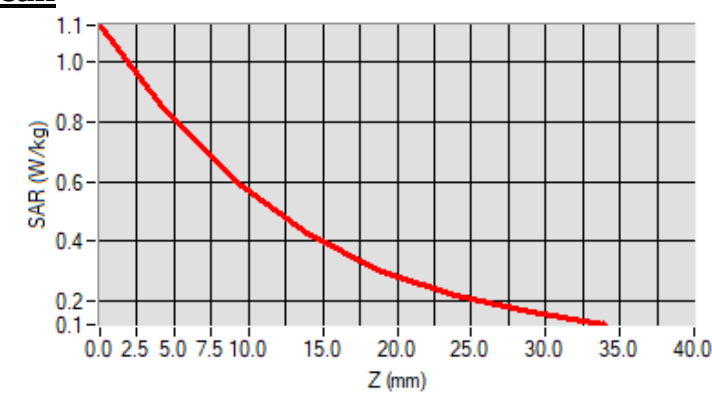


Maximum location: X=3.00, Y=2.00 ; SAR Peak: 1.13 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	0.567028
SAR 1g (W/Kg)	0.868015
Variation (%)	0.290000

E. Z Axis Scan



System check at 835 MHz

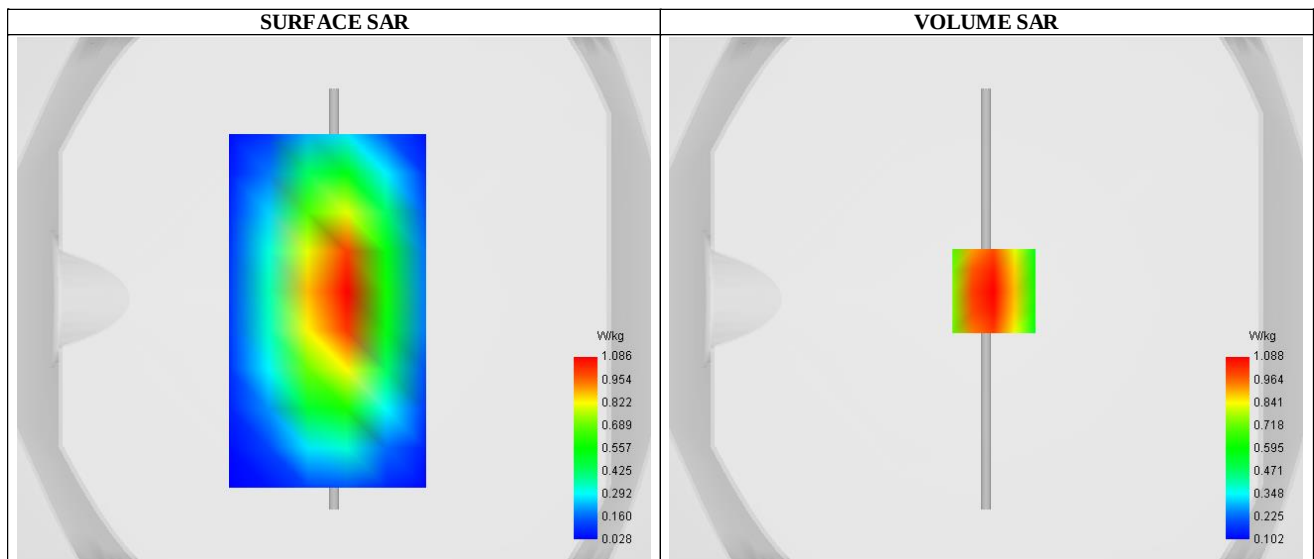
Date of measurement: 22/12/2022

A. Experimental conditions.

Probe	SN 18/21 EPG0354
ConvF	1.73
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Dipole
Band	CW835
Channels	Middle
Signal	CW (Crest factor: 1.0)

B. Permittivity

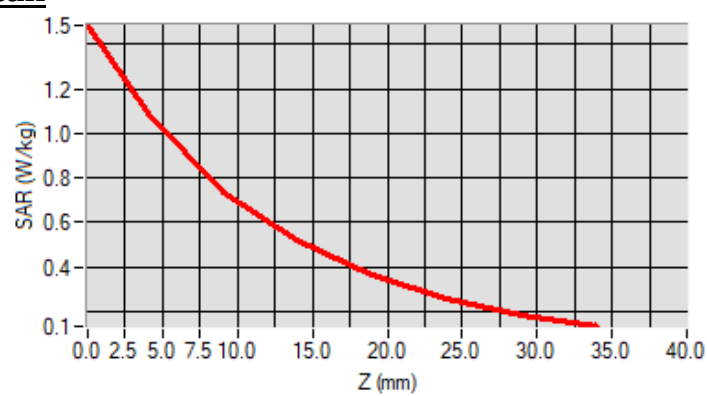
Frequency (MHz)	835.000000
Relative permittivity (real part)	42.360000
Conductivity (S/m)	0.920144

C. SAR Surface and Volume

Maximum location: X=3.00, Y=3.00 ; SAR Peak: 1.50 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	0.611320
SAR 1g (W/Kg)	0.965123
Variation (%)	-2.550000

E. Z Axis Scan

System check at 1750 MHz

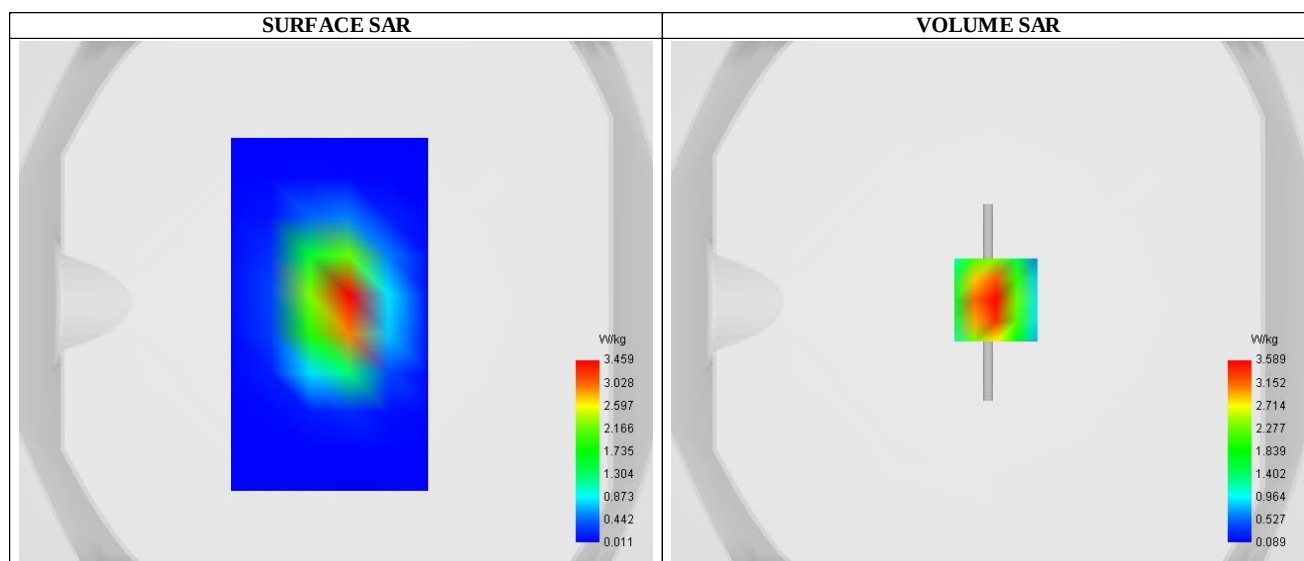
Date of measurement: 28/12/2022

A. Experimental conditions.

Probe	SN 18/21 EPG0354
ConvF	2.05
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Dipole
Band	CW1750
Channels	Middle
Signal	CW (Crest factor: 1.0)

B. Permittivity

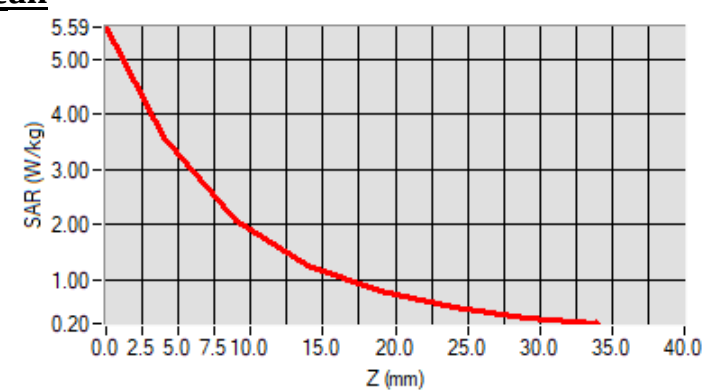
Frequency (MHz)	1750.000000
Relative permittivity (real part)	40.792263
Conductivity (S/m)	1.392861

C. SAR Surface and Volume

Maximum location: X=3.00, Y=1.00 ; SAR Peak: 5.69 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	1.925000
SAR 1g (W/Kg)	3.690195
Variation (%)	0.130000

E. Z Axis Scan

System check at 1900 MHz

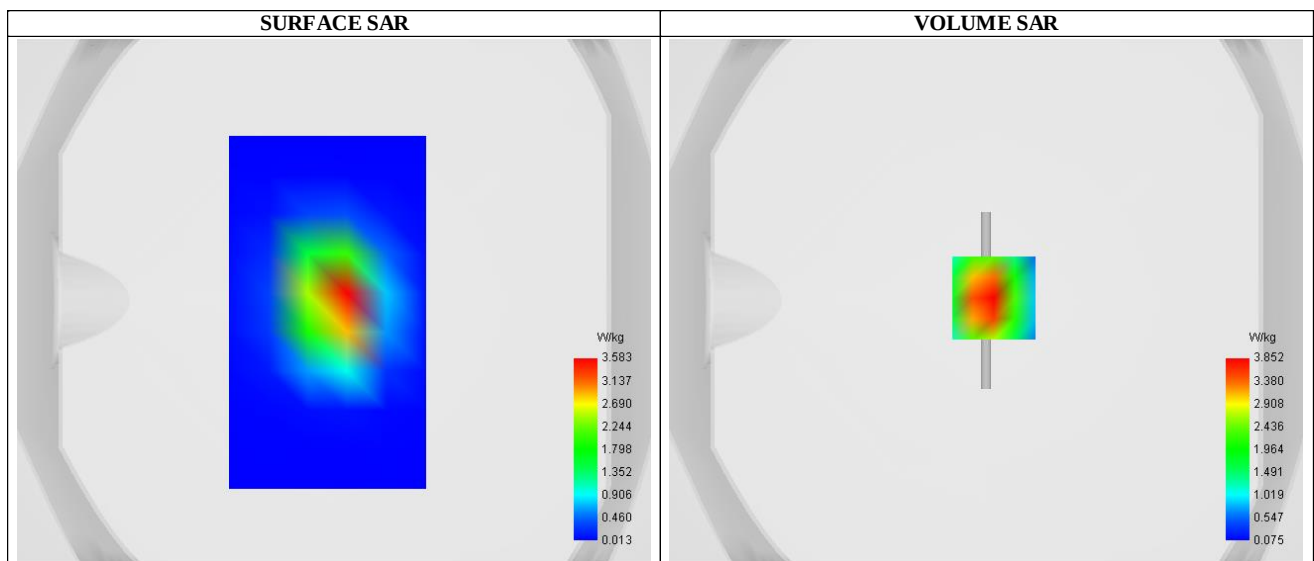
Date of measurement: 28/12/2022

A. Experimental conditions.

Probe	SN 18/21 EPG0354
ConvF	2.00
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Dipole
Band	CW1900
Channels	Middle
Signal	CW (Crest factor: 1.0)

B. Permittivity

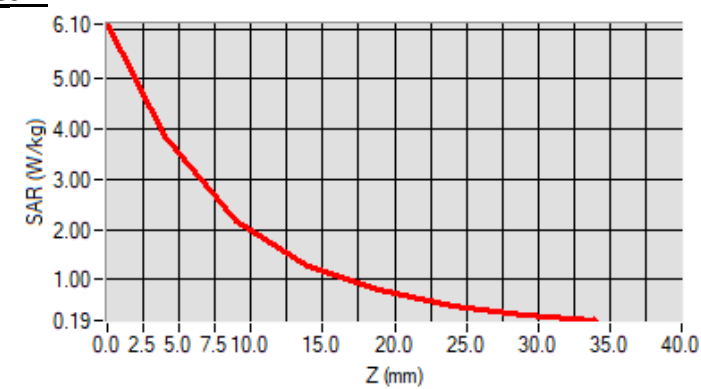
Frequency (MHz)	1900.000000
Relative permittivity (real part)	40.550000
Conductivity (S/m)	1.410315

C. SAR Surface and Volume

Maximum location: X=3.00, Y=1.00 ; SAR Peak: 6.27 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	2.069021
SAR 1g (W/Kg)	3.990221
Variation (%)	-1.630000

E. Z Axis Scan

System check at 2450 MHz

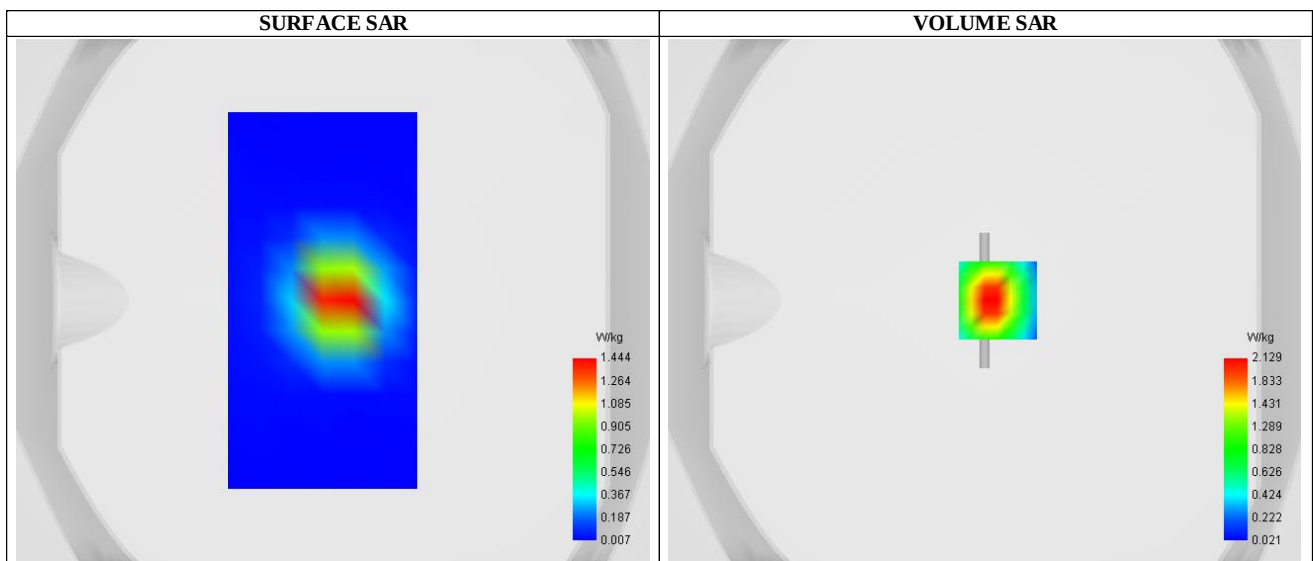
Date of measurement: 30/12/2022

A. Experimental conditions.

Probe	SN 18/21 EPG0354
ConvF	2.46
Area Scan	surf_sam_plan.txt
Zoom Scan	7x7x7,dx=5mm dy=5mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Dipole
Band	CW2450
Channels	Middle
Signal	CW (Crest factor: 1.0)

B. Permittivity

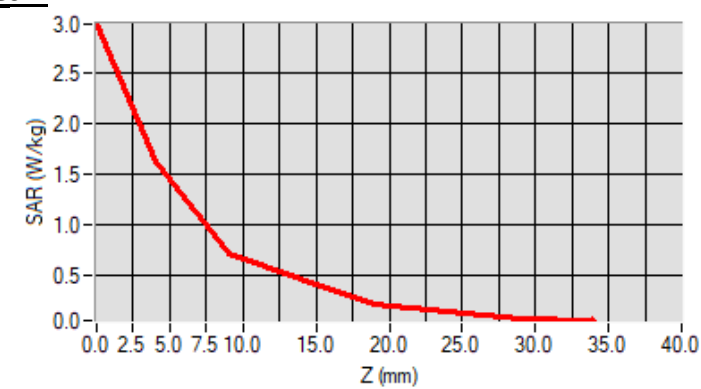
Frequency (MHz)	2450.000000
Relative permittivity (real part)	39.870234
Conductivity (S/m)	1.810357

C. SAR Surface and Volume

Maximum location: X=5.00, Y=0.00 ; SAR Peak: 2.67 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	0.993121
SAR 1g (W/Kg)	2.145031
Variation (%)	-0.020000

E. Z Axis Scan

System check at 2600 MHz

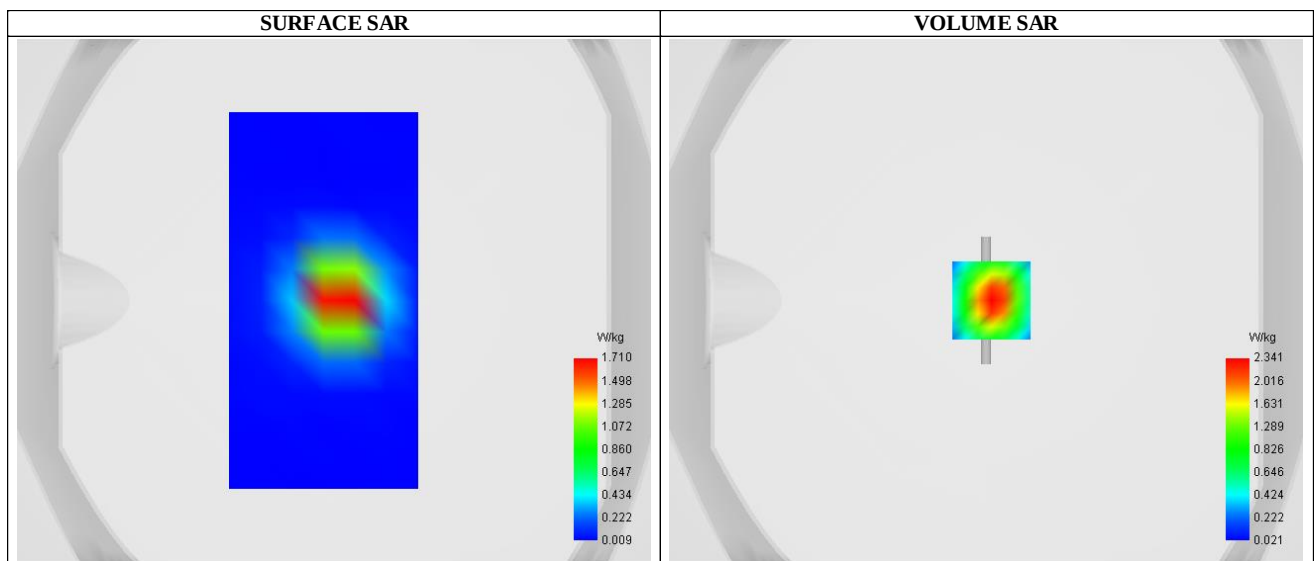
Date of measurement: 30/12/2022

A. Experimental conditions.

Probe	SN 18/21 EPG0354
ConvF	2.27
Area Scan	surf_sam_plan.txt
Zoom Scan	7x7x7,dx=5mm dy=5mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Dipole
Band	CW2600
Channels	Middle
Signal	CW (Crest factor: 1.0)

B. Permittivity

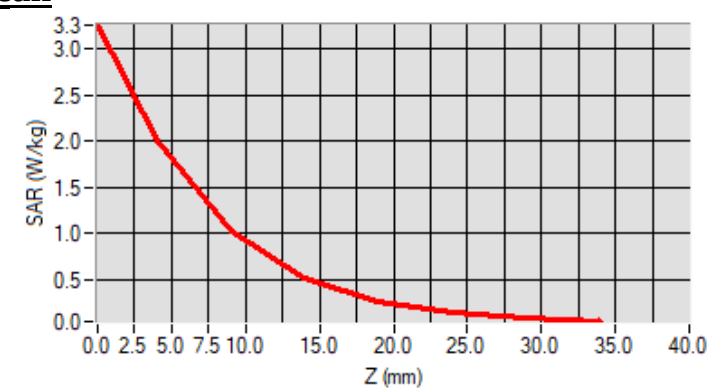
Frequency (MHz)	2600.000000
Relative permittivity (real part)	38.660000
Conductivity (S/m)	1.930111

C. SAR Surface and Volume

Maximum location: X=3.00, Y=0.00 ; SAR Peak: 3.24 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	0.960111
SAR 1g (W/Kg)	2.135115
Variation (%)	2.190000

E. Z Axis Scan

Appendix B: Plots of SAR Test Data

SAR Measurement at GSM850 (Cheek, Left)

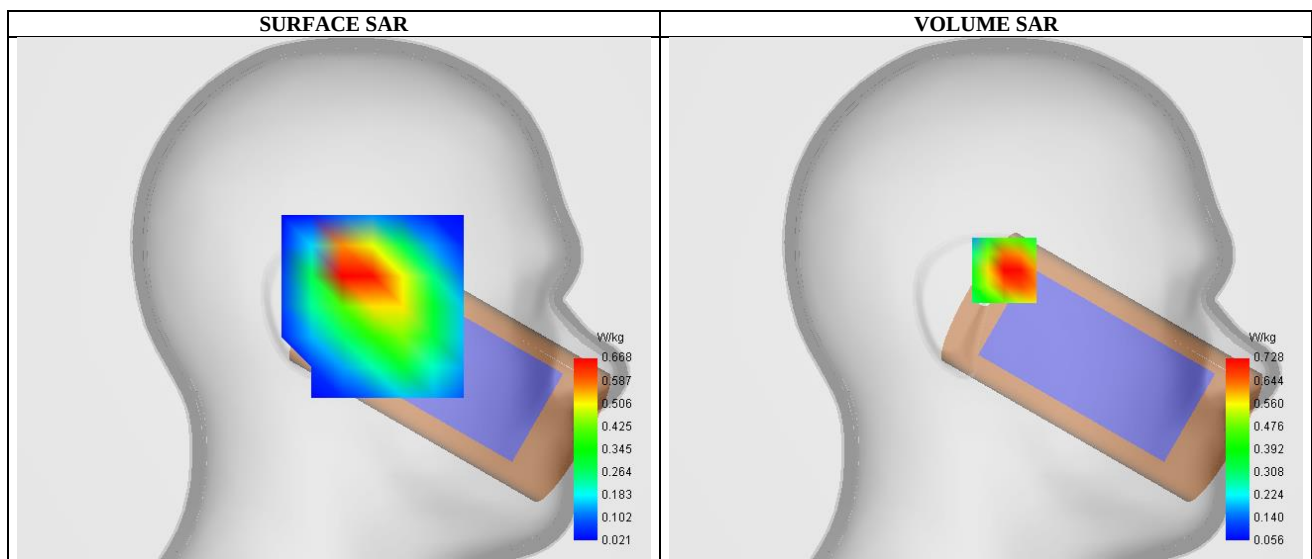
Date of measurement: 22/12/2022

A. Experimental conditions.

Probe	SN 18/21 EPG0354
ConvF	1.73
Area Scan	dx=15mm dy=15mm
Zoom Scan	5x5x7, dx=8mm dy=8mm dz=5mm, Complete
Phantom	Left head
Device Position	Cheek
Band	GSM850
Channels	Middle
Signal	TDMA (Crest factor: 8.0)

B. Permittivity

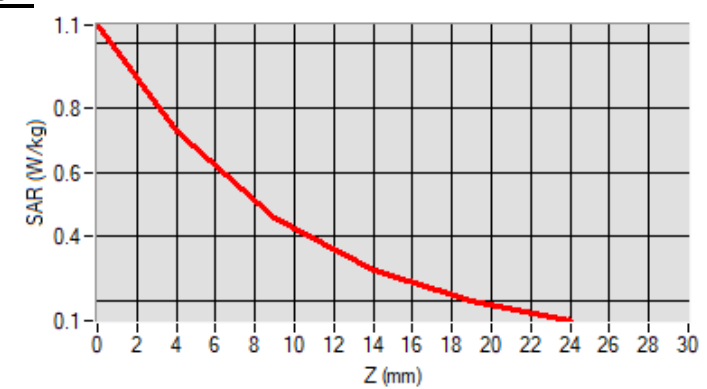
Frequency (MHz)	836.599976
Relative permittivity (real part)	42.366322
Conductivity (S/m)	0.920113

C. SAR Surface and Volume

Maximum location: X=-9.00, Y=15.00 ; SAR Peak: 1.07 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	0.440022
SAR 1g (W/Kg)	0.701691
Variation (%)	-2.280000

E. Z Axis Scan

SAR Measurement at GSM1900 (Tilt, Left)

Date of measurement: 28/12/2022

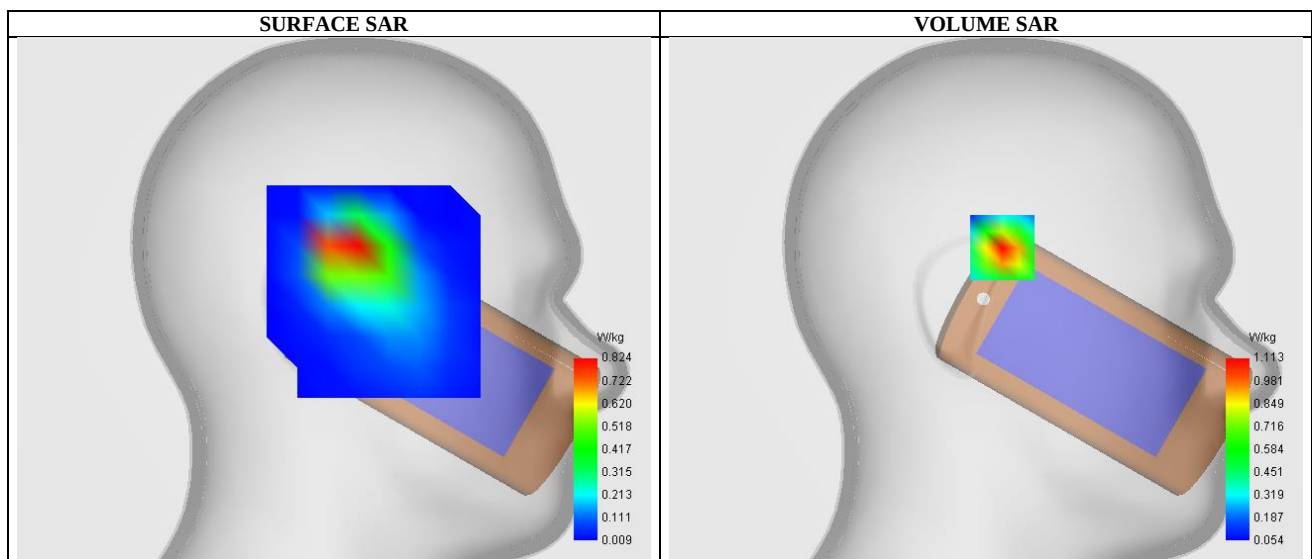
A. Experimental conditions.

Probe	SN 18/21 EPG0354
ConvF	2.00
Area Scan	dx=15mm dy=15mm
Zoom Scan	5x5x7, dx=8mm dy=8mm dz=5mm, Complete
Phantom	Left head
Device Position	Tilt
Band	GSM1900
Channels	Low
Signal	TDMA (Crest factor: 8.0)

B. Permittivity

Frequency (MHz)	1850.199951
Relative permittivity (real part)	40.100000
Conductivity (S/m)	1.400260

C. SAR Surface and Volume

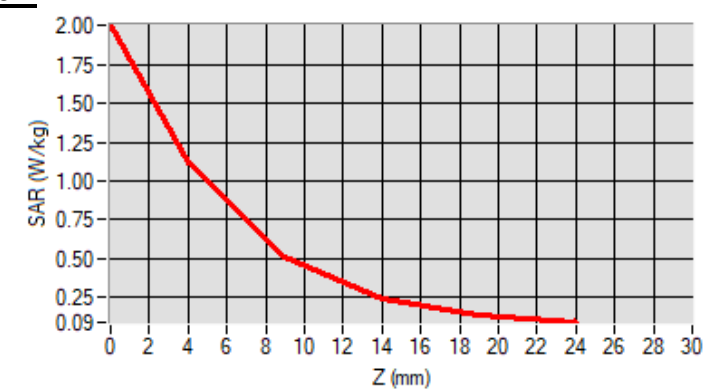


Maximum location: X=-8.00, Y=26.00 ; SAR Peak: 2.03 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	0.497443
SAR 1g (W/Kg)	1.035361
Variation (%)	-0.690000

E. Z Axis Scan



SAR Measurement at Band2_WCDMA1900 (Tilt, Left)

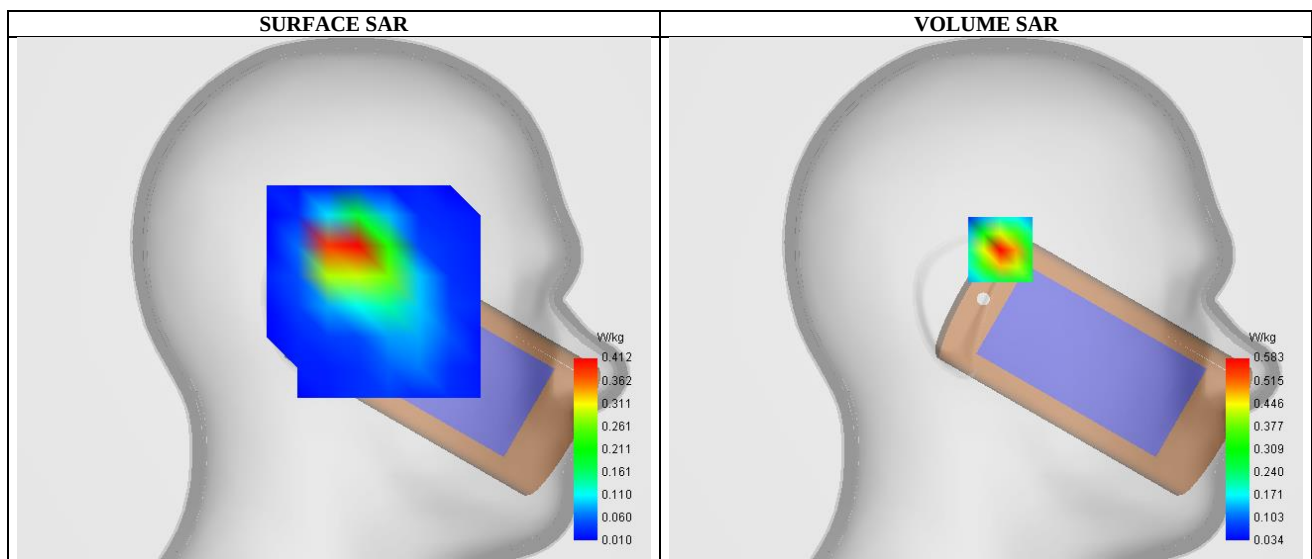
Date of measurement: 28/12/2022

A. Experimental conditions.

Probe	SN 18/21 EPG0354
ConvF	2.00
Area Scan	dx=15mm dy=15mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Left head
Device Position	Tilt
Band	Band2_WCDMA1900
Channels	Low
Signal	WCDMA (Crest factor: 1.0)

B. Permittivity

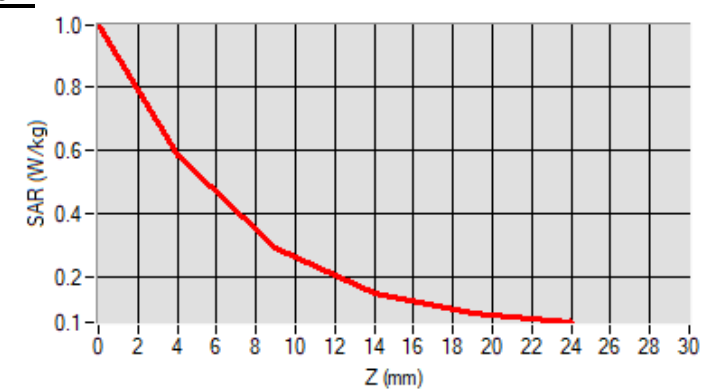
Frequency (MHz)	1852.400024
Relative permittivity (real part)	40.110000
Conductivity (S/m)	1.400011

C. SAR Surface and Volume

Maximum location: X=-7.00, Y=25.00 ; SAR Peak: 1.00 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	0.266947
SAR 1g (W/Kg)	0.538300
Variation (%)	-2.610000

E. Z Axis Scan

SAR Measurement at CUSTOM (WCDMA 1700) (Tilt, Left)

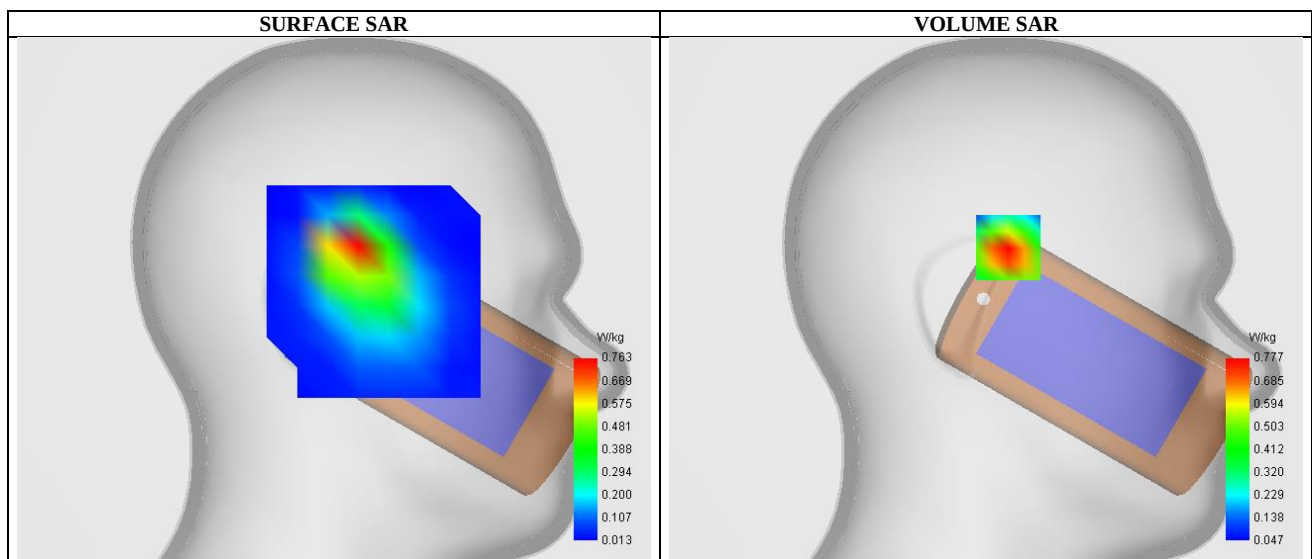
Date of measurement: 28/12/2022

A. Experimental conditions.

Probe	SN 18/21 EPG0354
ConvF	2.05
Area Scan	dx=15mm dy=15mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Left head
Device Position	Tilt
Band	Band4_WCDMA1700
Channels	Low
Signal	WCDMA (Crest factor: 1.0)

B. Permittivity

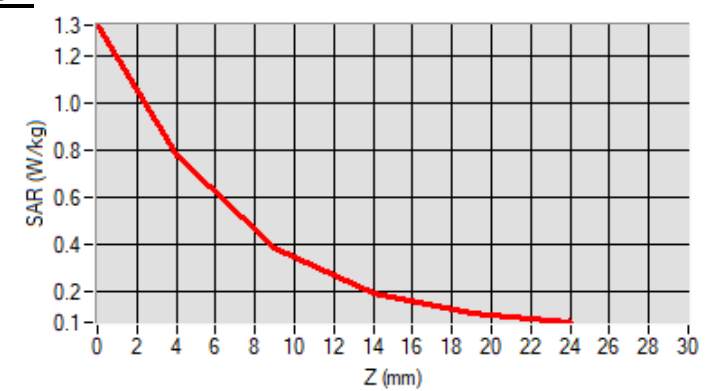
Frequency (MHz)	1712.400024
Relative permittivity (real part)	40.134122
Conductivity (S/m)	1.383519

C. SAR Surface and Volume

Maximum location: X=-11.00, Y=26.00 ; SAR Peak: 1.35 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	0.384986
SAR 1g (W/Kg)	0.734961
Variation (%)	-3.650000

E. Z Axis Scan

SAR Measurement at Band5_WCDMA850 (Cheek, Left)

Date of measurement: 22/12/2022

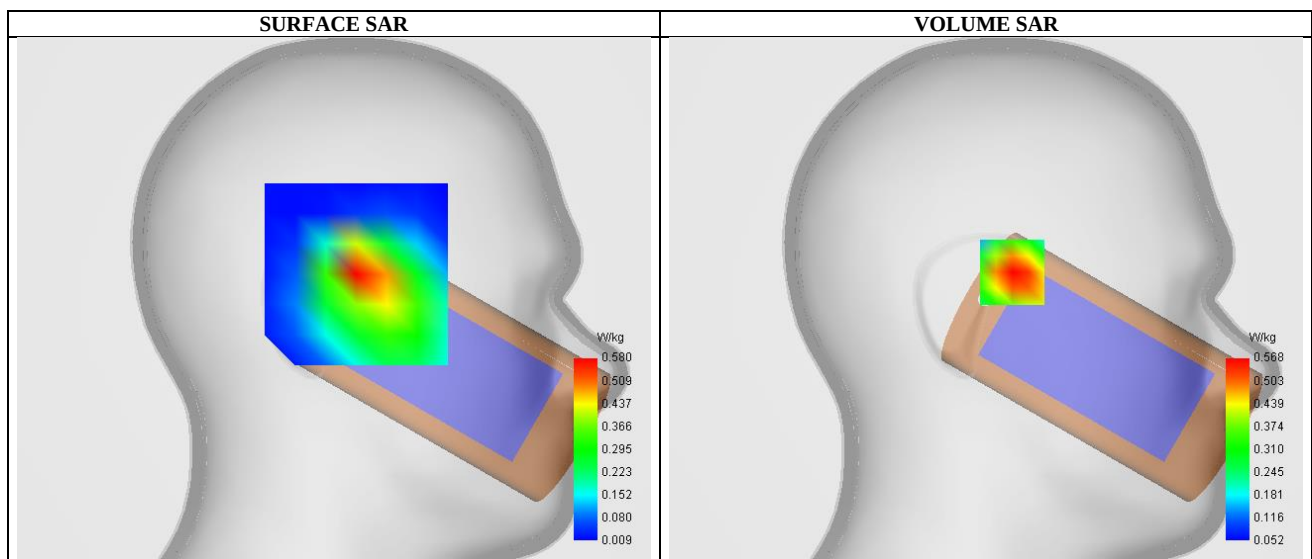
A. Experimental conditions.

Probe	SN 18/21 EPG0354
ConvF	1.73
Area Scan	dx=15mm dy=15mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Left head
Device Position	Cheek
Band	Band5_WCDMA850
Channels	Middle
Signal	WCDMA (Crest factor: 1.0)

B. Permittivity

Frequency (MHz)	836.599976
Relative permittivity (real part)	42.366322
Conductivity (S/m)	0.920113

C. SAR Surface and Volume

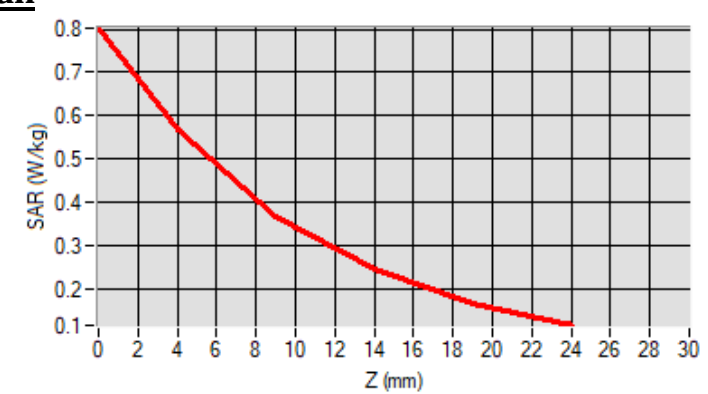


Maximum location: X=-13.00, Y=14.00 ; SAR Peak: 0.80 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	0.339195
SAR 1g (W/Kg)	0.538637
Variation (%)	-4.520000

E. Z Axis Scan



SAR Measurement at LTE band 2 (Tilt, Left)

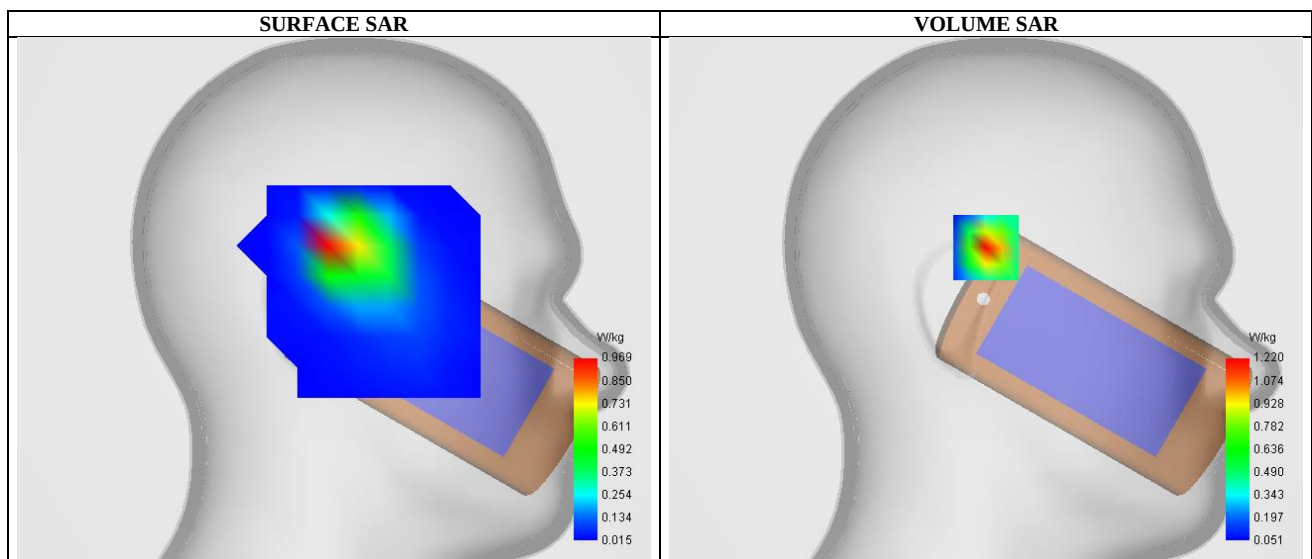
Date of measurement: 28/12/2022

A. Experimental conditions.

Probe	SN 18/21 EPG0354
ConvF	2.00
Area Scan	dx=15mm dy=15mm
Zoom Scan	5x5x7, dx=8mm dy=8mm dz=5mm, Complete
Phantom	Left head
Device Position	Tilt
Band	LTE band 2
Channels	High
Signal	LTE (Crest factor: 1.0)

B. Permittivity

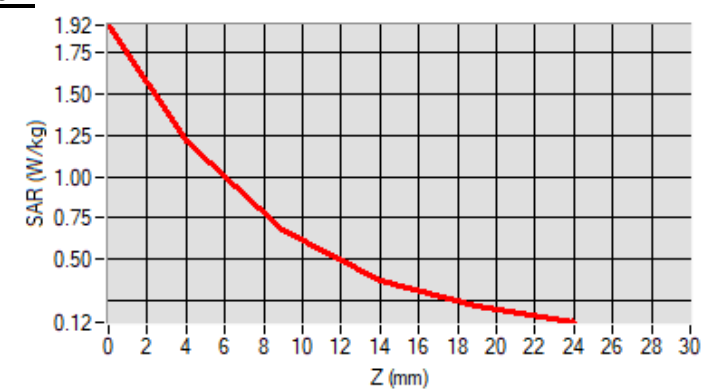
Frequency (MHz)	1900.000000
Relative permittivity (real part)	40.550000
Conductivity (S/m)	1.410315

C. SAR Surface and Volume

Maximum location: X=0.00, Y=26.00 ; SAR Peak: 1.96 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	0.538830
SAR 1g (W/Kg)	1.109037
Variation (%)	-0.150000

E. Z Axis Scan

SAR Measurement at LTE band 5 (Cheek, Left)

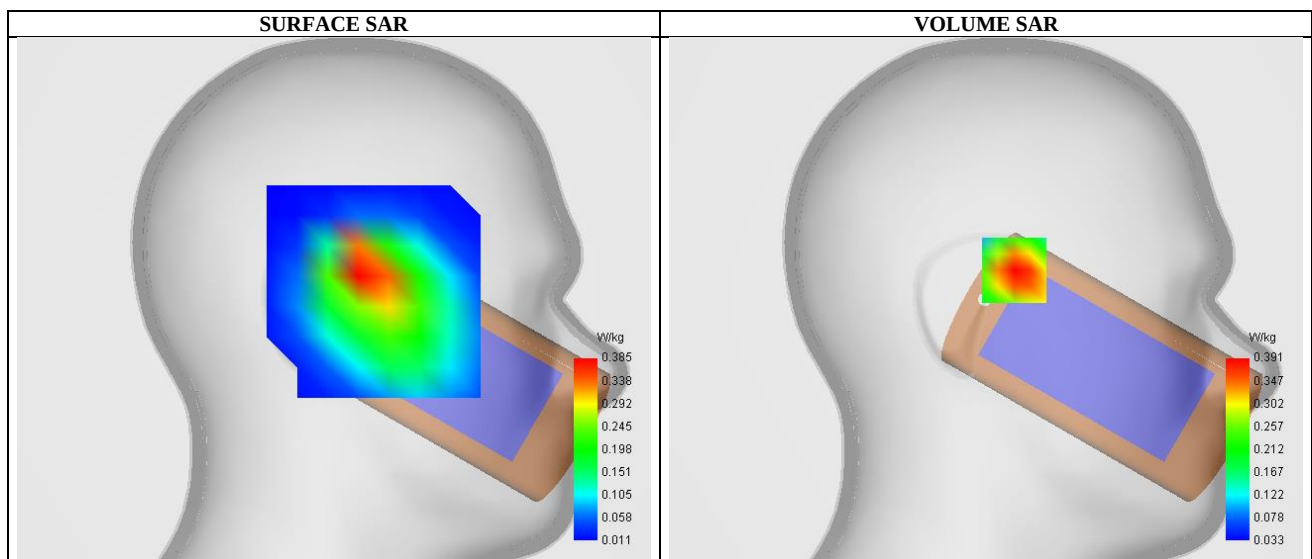
Date of measurement: 22/12/2022

A. Experimental conditions.

Probe	SN 18/21 EPG0354
ConvF	1.73
Area Scan	dx=15mm dy=15mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Left head
Device Position	Cheek
Band	LTE band 5
Channels	Low
Signal	LTE (Crest factor: 1.0)

B. Permittivity

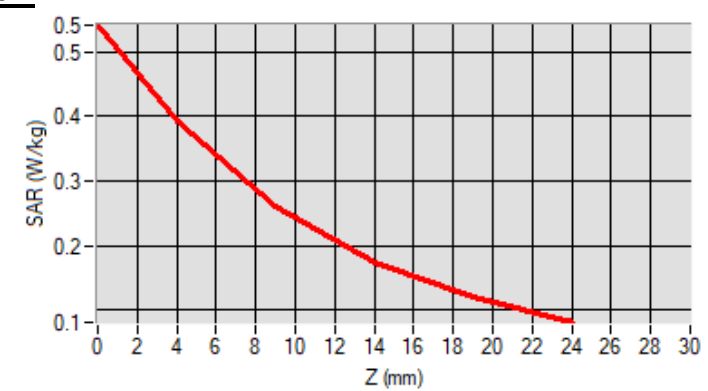
Frequency (MHz)	829.000000
Relative permittivity (real part)	42.123236
Conductivity (S/m)	0.911503

C. SAR Surface and Volume

Maximum location: X=-14.00, Y=15.00 ; SAR Peak: 0.54 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	0.237128
SAR 1g (W/Kg)	0.371263
Variation (%)	-4.720000

E. Z Axis Scan

SAR Measurement at LTE band 12 (Cheek, Left)

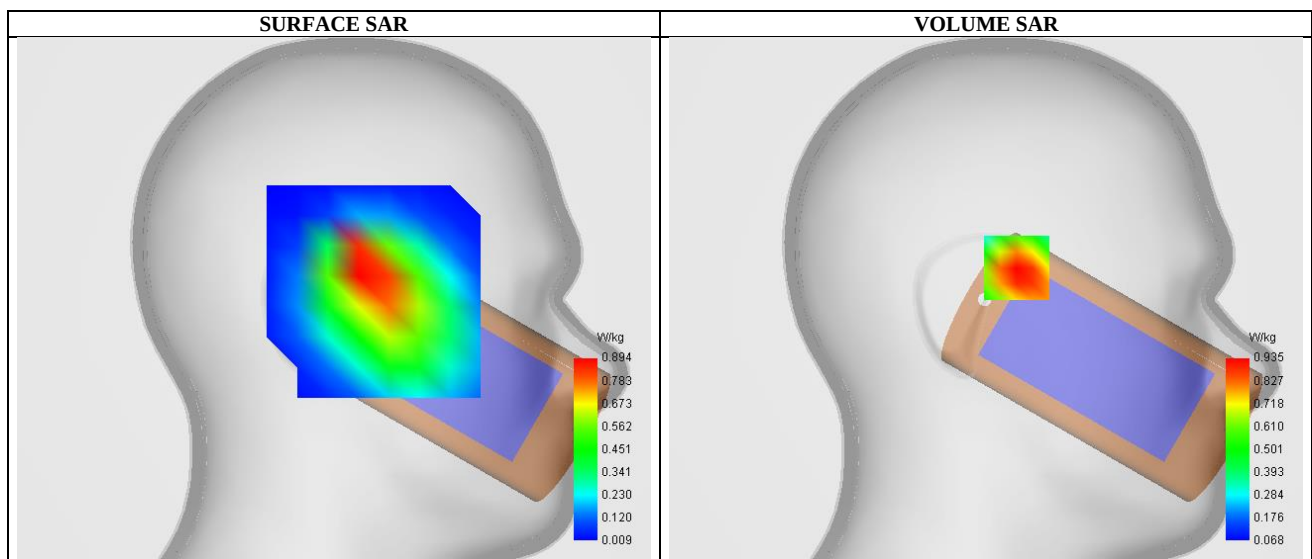
Date of measurement: 22/12/2022

A. Experimental conditions.

Probe	SN 18/21 EPG0354
ConvF	1.70
Area Scan	dx=15mm dy=15mm
Zoom Scan	5x5x7, dx=8mm dy=8mm dz=5mm, Complete
Phantom	Left head
Device Position	Cheek
Band	LTE band 12
Channels	Low
Signal	LTE (Crest factor: 1.0)

B. Permittivity

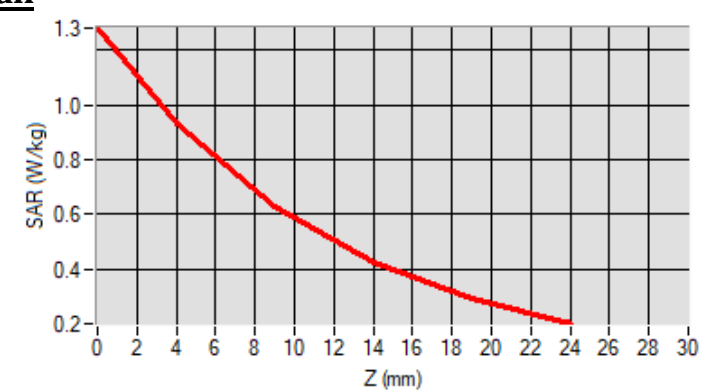
Frequency (MHz)	704.000000
Relative permittivity (real part)	42.131332
Conductivity (S/m)	0.891015

C. SAR Surface and Volume

Maximum location: X=-15.00, Y=16.00 ; SAR Peak: 1.28 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	0.611743
SAR 1g (W/Kg)	0.916805
Variation (%)	0.120000

E. Z Axis Scan

SAR Measurement at LTE band 41 (Tilt, Left)

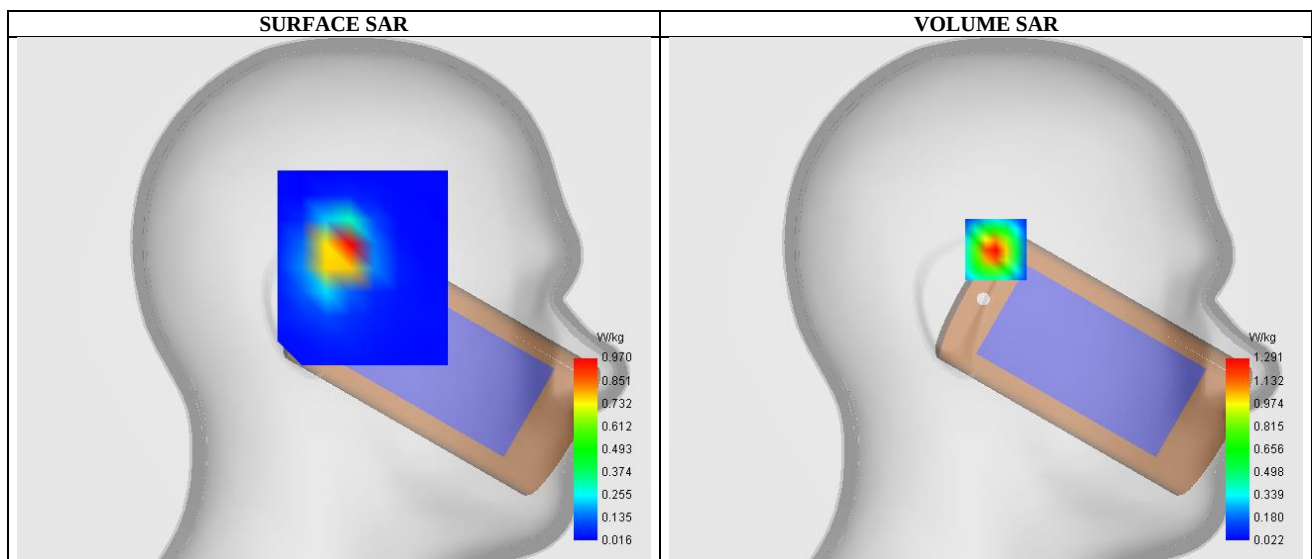
Date of measurement: 30/12/2022

A. Experimental conditions.

Probe	SN 18/21 EPG0354
ConvF	2.27
Area Scan	dx=12mm dy=12mm
Zoom Scan	7x7x7, dx=5mm dy=5mm dz=5mm, Complete
Phantom	Left head
Device Position	Tilt
Band	LTE band 41
Channels	Middle
Signal	LTE (Crest factor: 1.0)

B. Permittivity

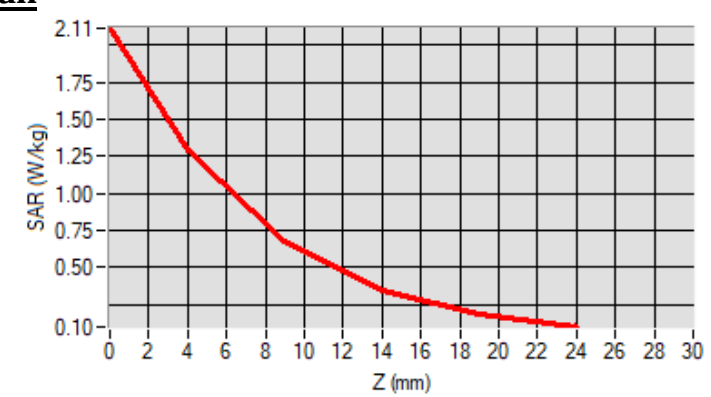
Frequency (MHz)	2605.000000
Relative permittivity (real part)	38.675323
Conductivity (S/m)	1.933482

C. SAR Surface and Volume

Maximum location: X=-5.00, Y=25.00 ; SAR Peak: 2.12 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	0.516855
SAR 1g (W/Kg)	1.128398
Variation (%)	1.520000

E. Z Axis Scan

SAR Measurement at CUSTOM (LTE Band66) (Tilt, Left)

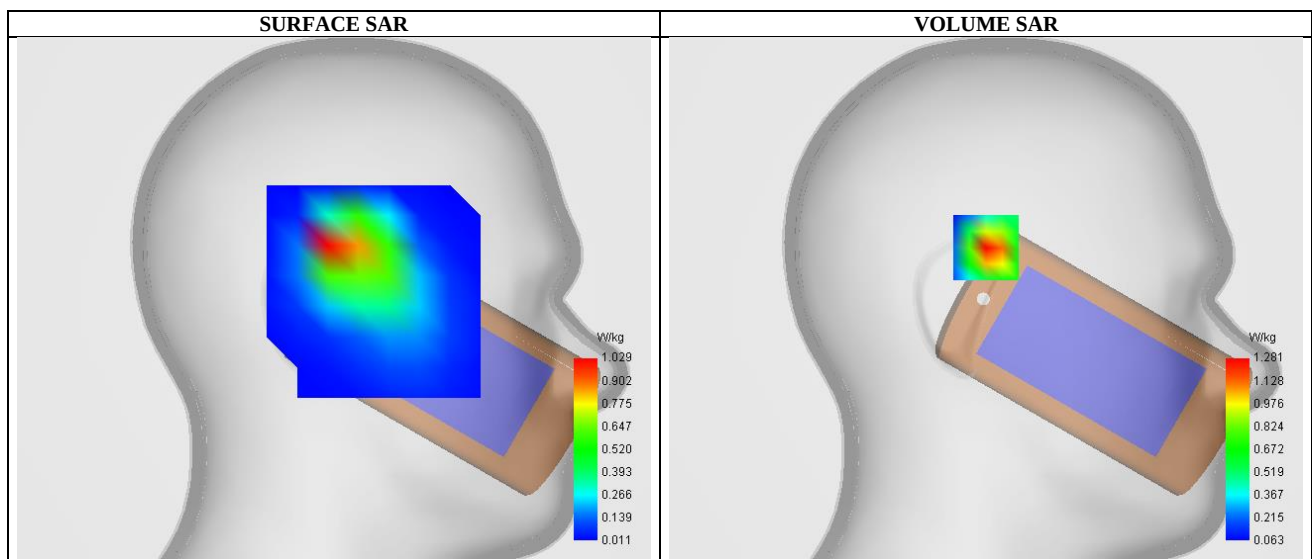
Date of measurement: 28/12/2022

A. Experimental conditions.

Probe	SN 18/21 EPG0354
ConvF	2.05
Area Scan	dx=15mm dy=15mm
Zoom Scan	5x5x7, dx=8mm dy=8mm dz=5mm, Complete
Phantom	Left head
Device Position	Tilt
Band	LTE band 66
Channels	High
Signal	LTE (Crest factor: 1.0)

B. Permittivity

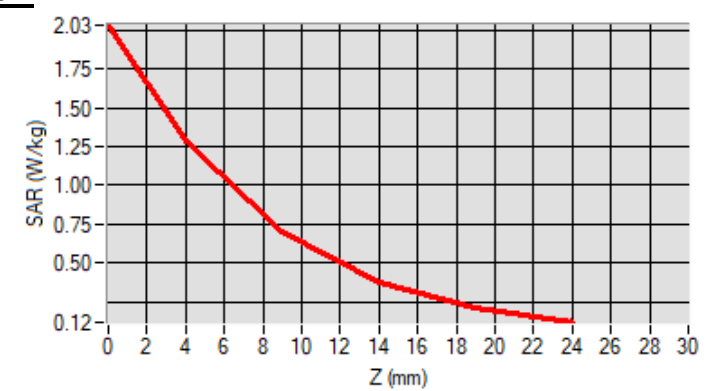
Frequency (MHz)	1770.000000
Relative permittivity (real part)	40.960001
Conductivity (S/m)	1.401267

C. SAR Surface and Volume

Maximum location: X=0.00, Y=26.00 ; SAR Peak: 2.10 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	0.592416
SAR 1g (W/Kg)	1.187796
Variation (%)	-0.020000

E. Z Axis Scan

SAR Measurement at CUSTOM (LTE Band 71) (Cheek, Left)

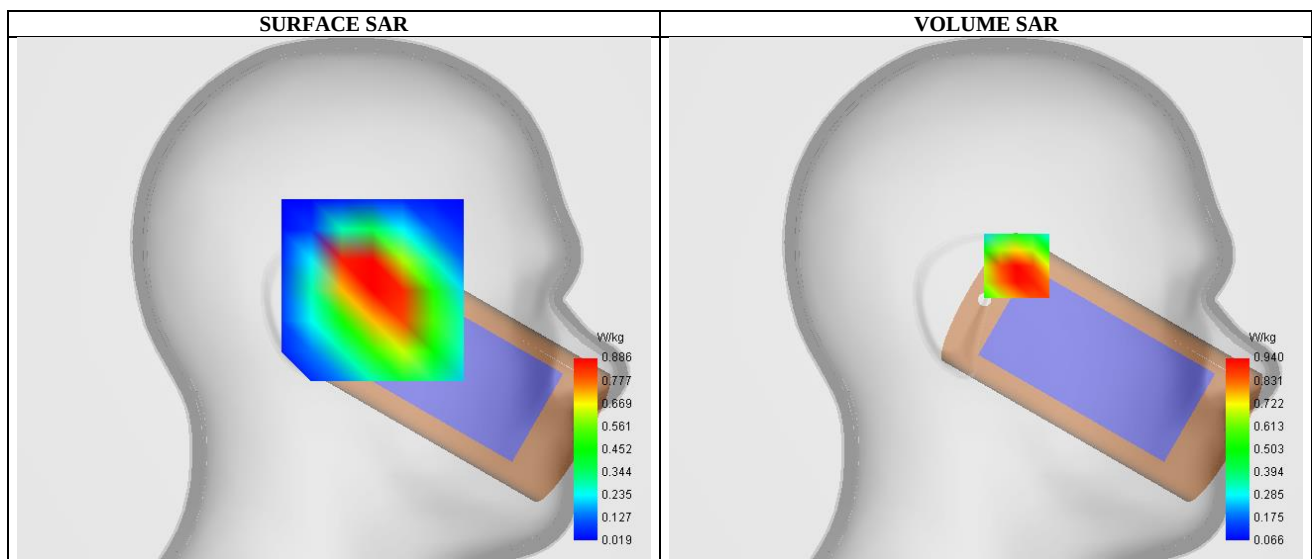
Date of measurement: 22/12/2022

A. Experimental conditions.

Probe	SN 18/21 EPG0354
ConvF	1.70
Area Scan	dx=15mm dy=15mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Left head
Device Position	Cheek
Band	LTE band 71
Channels	High
Signal	LTE (Crest factor: 1.0)

B. Permittivity

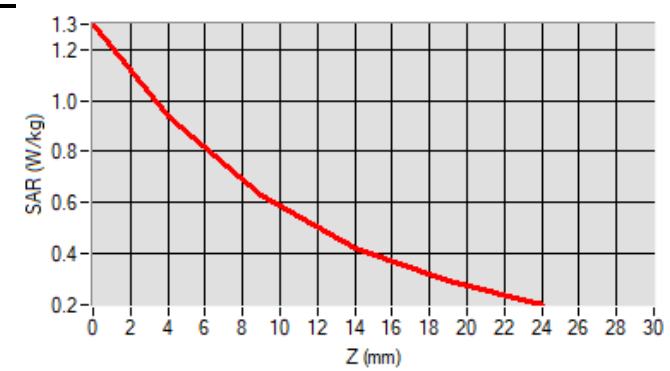
Frequency (MHz)	688.000000
Relative permittivity (real part)	42.025132
Conductivity (S/m)	0.892437

C. SAR Surface and Volume

Maximum location: X=-15.00, Y=17.00 ; SAR Peak: 1.32 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	0.622624
SAR 1g (W/Kg)	0.941917
Variation (%)	-4.130000

E. Z Axis Scan

SAR Measurement at IEEE 802.11b ISM (Cheek, Right)

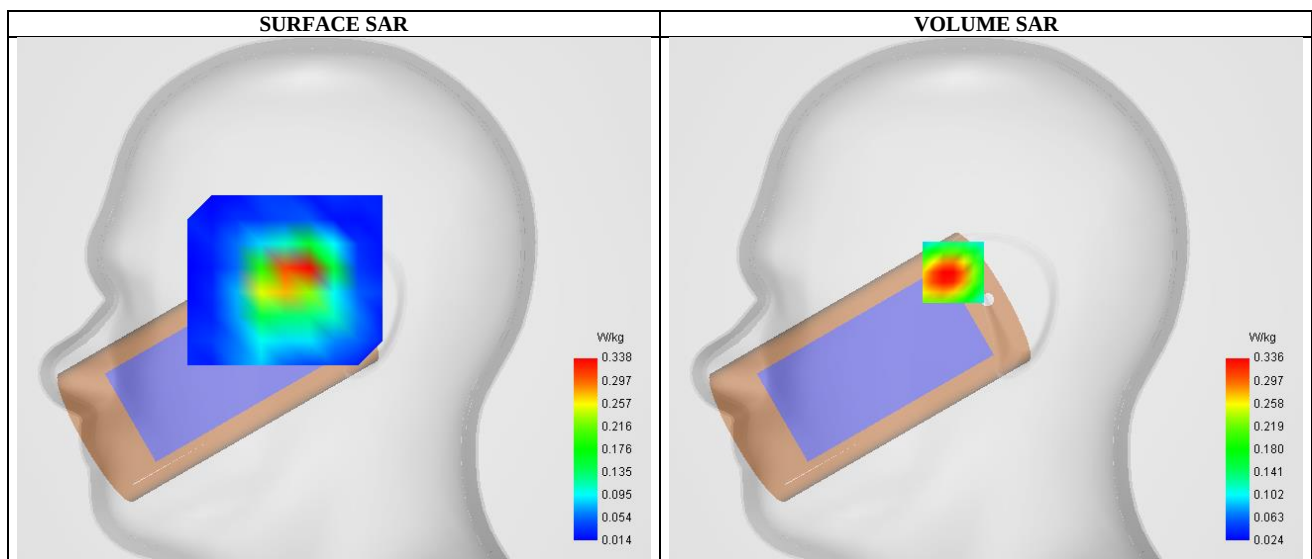
Date of measurement: 30/12/2022

A. Experimental conditions.

Probe	SN 18/21 EPG0354
ConvF	2.46
Area Scan	dx=12mm dy=12mm
Zoom Scan	7x7x7,dx=5mm dy=5mm dz=5mm,Complete
Phantom	Right head
Device Position	Cheek
Band	IEEE 802.11b ISM
Channels	Low
Signal	IEEE802.b (Crest factor: 1.0)

B. Permittivity

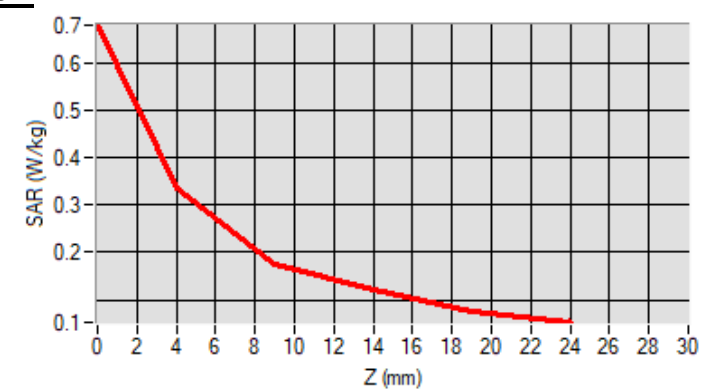
Frequency (MHz)	2412.000000
Relative permittivity (real part)	39.360021
Conductivity (S/m)	1.796382

C. SAR Surface and Volume

Maximum location: X=-16.00, Y=14.00 ; SAR Peak: 0.52 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	0.181494
SAR 1g (W/Kg)	0.316227
Variation (%)	-1.050000

E. Z Axis Scan

SAR Measurement at Bluetooth (Cheek, Right)

Date of measurement: 30/12/2022

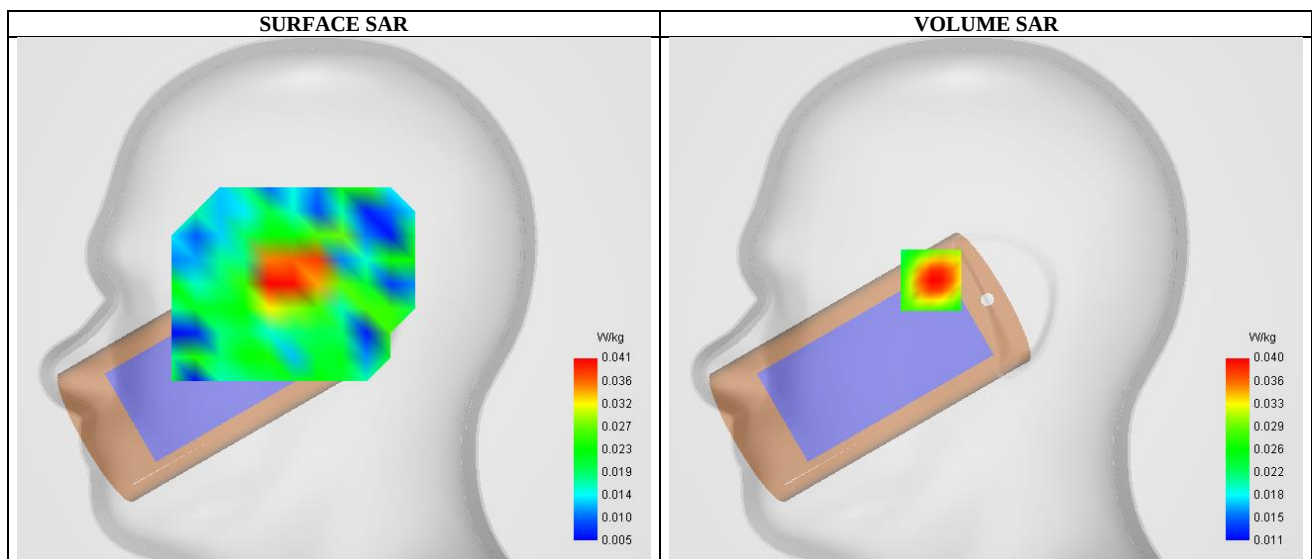
A. Experimental conditions.

Probe	SN 18/21 EPG0354
ConvF	2.46
Area Scan	dx=12mm dy=12mm
Zoom Scan	7x7x7,dx=5mm dy=5mm dz=5mm,Complete
Phantom	Right head
Device Position	Cheek
Band	Bluetooth
Channels	Middle
Signal	Bluetooth (Crest factor: 1.0)

B. Permittivity

Frequency (MHz)	2441.000000
Relative permittivity (real part)	39.202000
Conductivity (S/m)	1.791220

C. SAR Surface and Volume

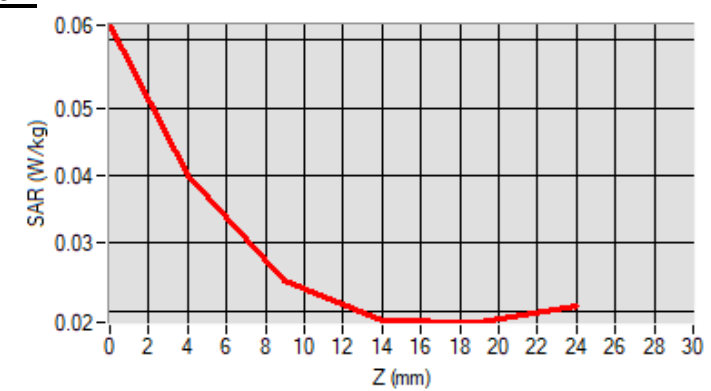


Maximum location: X=-27.00, Y=10.00 ; SAR Peak: 0.06 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	0.026249
SAR 1g (W/Kg)	0.038327
Variation (%)	-0.049999

E. Z Axis Scan



SAR Measurement at CUSTOM (BLE_1M) (Cheek, Right)

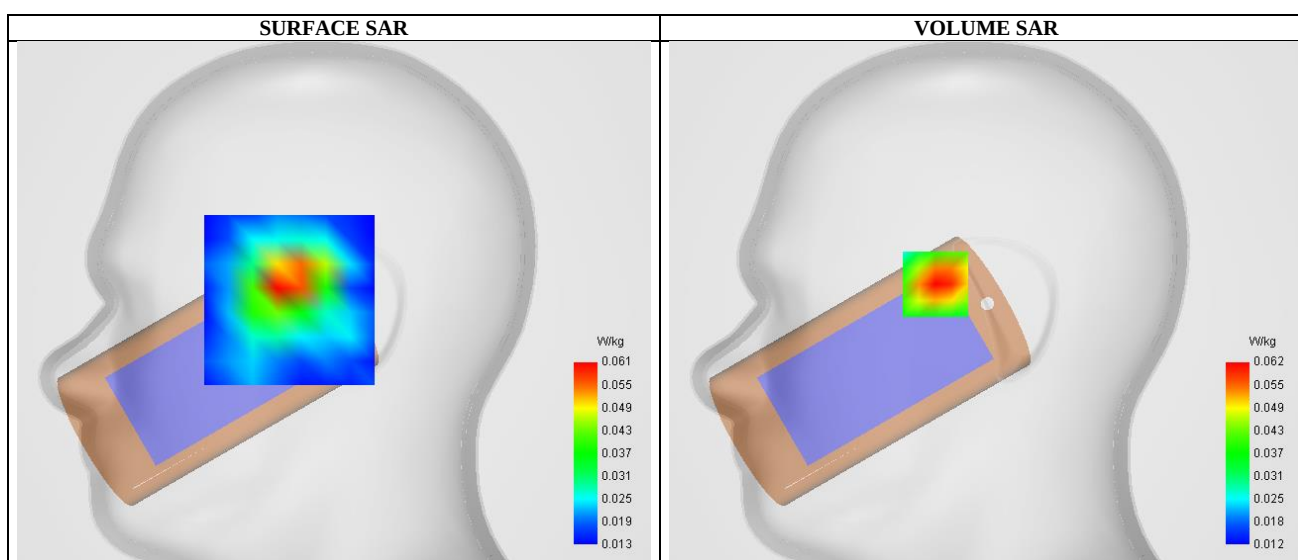
Date of measurement: 30/12/2022

A. Experimental conditions.

Probe	SN 18/21 EPG0354
ConvF	2.46
Area Scan	dx=12mm dy=12mm
Zoom Scan	5x5x7, dx=5mm dy=5mm dz=5mm, Complete
Phantom	Right head
Device Position	Cheek
Band	BLE
Channels	Middle
Signal	BLE (Crest factor: 1.0)

B. Permittivity

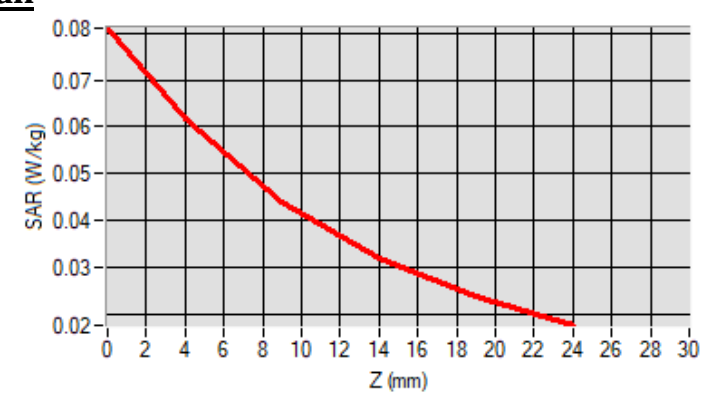
Frequency (MHz)	2442.000000
Relative permittivity (real part)	39.216000
Conductivity (S/m)	1.792223

C. SAR Surface and Volume

Maximum location: X=-25.00, Y=10.00 ; SAR Peak: 0.08 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	0.039694
SAR 1g (W/Kg)	0.058554
Variation (%)	1.350000

E. Z Axis Scan

SAR Measurement at CUSTOM (GPRS8504Txslots) (Body, Validation Plane)

Date of measurement: 22/12/2022

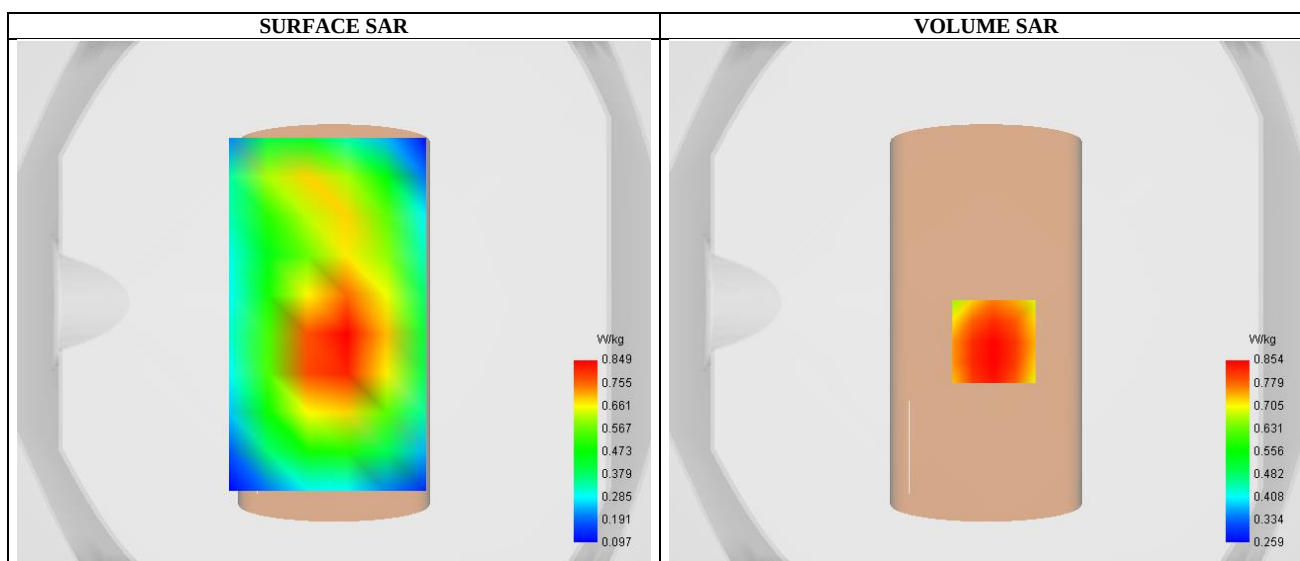
A. Experimental conditions.

Probe	SN 18/21 EPG0354
ConvF	1.70
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Body
Band	GSM 850
Channels	Middle
Signal	TDMA (Crest factor: 2.0)

B. Permittivity

Frequency (MHz)	836.599976
Relative permittivity (real part)	42.366322
Conductivity (S/m)	0.920113

C. SAR Surface and Volume

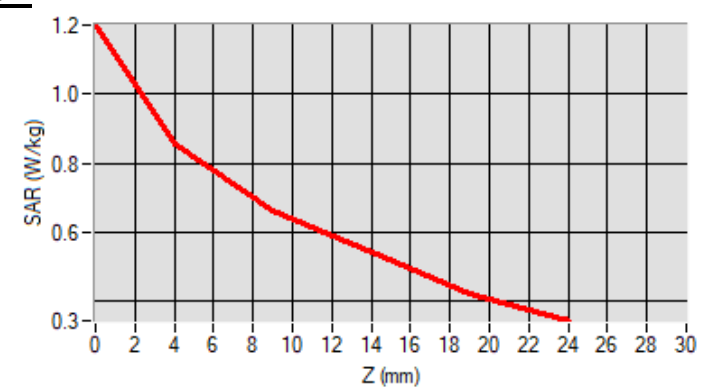


Maximum location: X=3.00, Y=-15.00 ; SAR Peak: 1.02 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	0.645997
SAR 1g (W/Kg)	0.846843
Variation (%)	-4.220000

E. Z Axis Scan



SAR Measurement at CUSTOM (GPRS19004Txslots) (Body, Validation Plane)

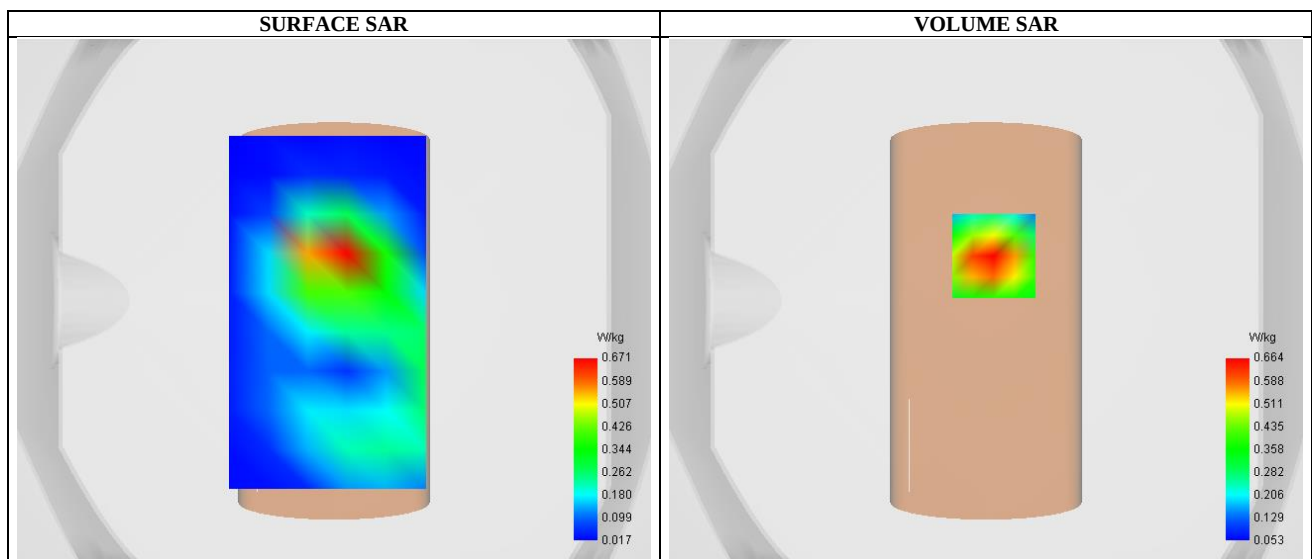
Date of measurement: 28/12/2022

A. Experimental conditions.

Probe	SN 18/21 EPG0354
ConvF	2.00
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Body
Band	GSM 1900
Channels	Low
Signal	TDMA (Crest factor: 2.0)

B. Permittivity

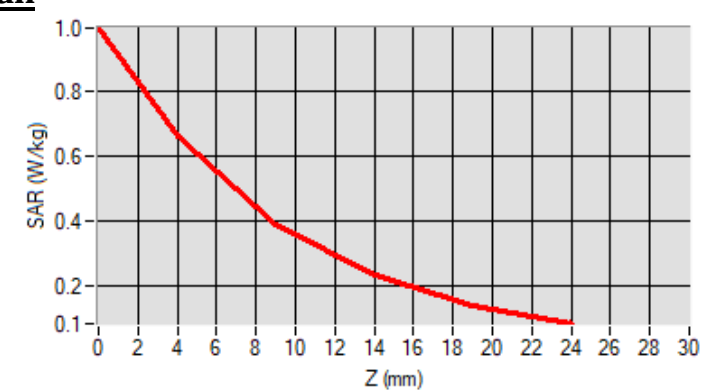
Frequency (MHz)	1850.199951
Relative permittivity (real part)	40.100000
Conductivity (S/m)	1.400260

C. SAR Surface and Volume

Maximum location: X=3.00, Y=17.00 ; SAR Peak: 1.01 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	0.350849
SAR 1g (W/Kg)	0.624606
Variation (%)	-0.730000

E. Z Axis Scan

SAR Measurement at Band2_WCDMA1900 (Body, Validation Plane)

Date of measurement: 28/12/2022

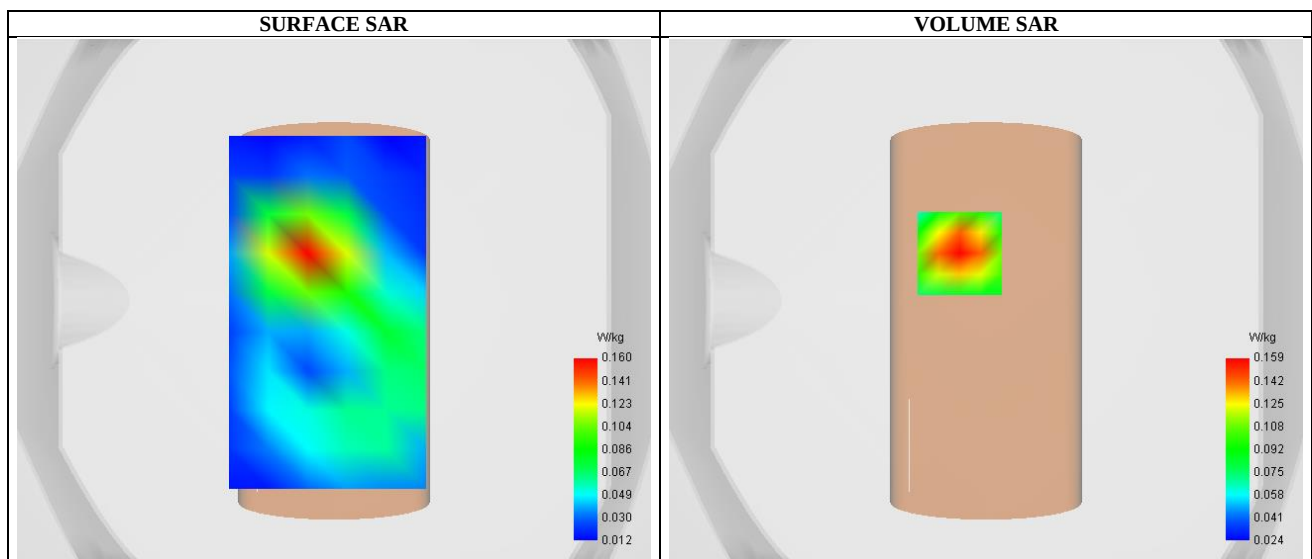
A. Experimental conditions.

Probe	SN 18/21 EPG0354
ConvF	2.00
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Body
Band	Band2_WCDMA1900
Channels	Low
Signal	WCDMA (Crest factor: 1.0)

B. Permittivity

Frequency (MHz)	1852.400024
Relative permittivity (real part)	40.110000
Conductivity (S/m)	1.400011

C. SAR Surface and Volume

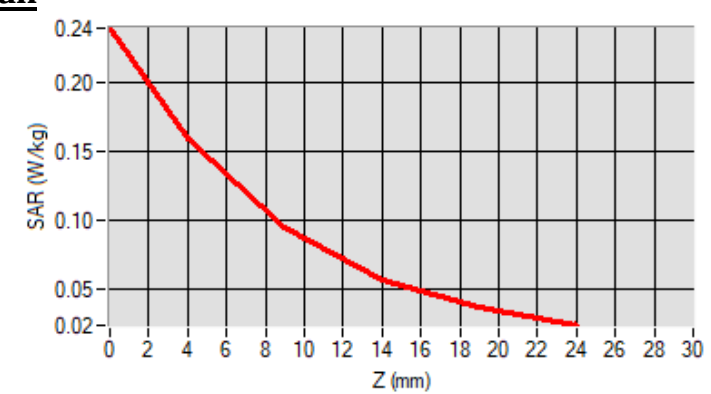


Maximum location: X=-10.00, Y=18.00 ; SAR Peak: 0.24 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	0.088694
SAR 1g (W/Kg)	0.149691
Variation (%)	0.460000

E. Z Axis Scan



SAR Measurement at CUSTOM (WCDMA_1700) (Body, Validation Plane)

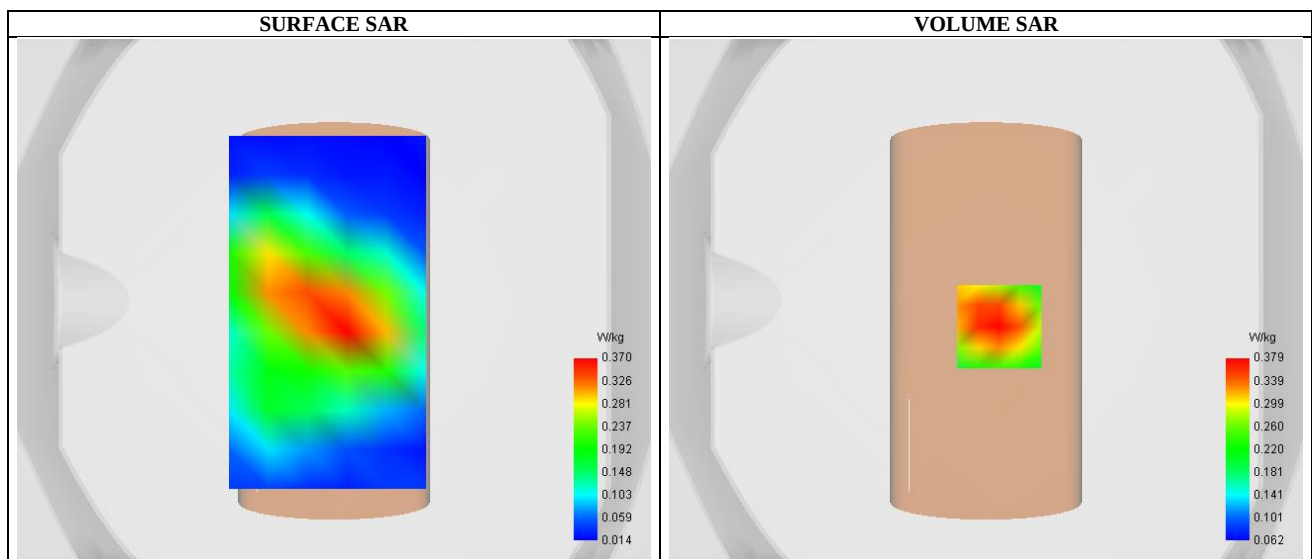
Date of measurement: 28/12/2022

A. Experimental conditions.

Probe	SN 18/21 EPG0354
ConvF	2.05
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Body
Band	Band4_WCDMA1700
Channels	Low
Signal	WCDMA (Crest factor: 1.0)

B. Permittivity

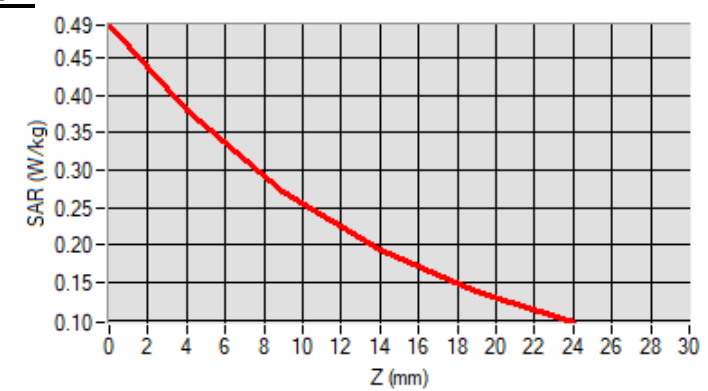
Frequency (MHz)	1712.400024
Relative permittivity (real part)	40.134122
Conductivity (S/m)	1.383519

C. SAR Surface and Volume

Maximum location: X=5.00, Y=-10.00 ; SAR Peak: 0.43 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	0.209681
SAR 1g (W/Kg)	0.315225
Variation (%)	1.430000

E. Z Axis Scan

SAR Measurement at Band5_WCDMA850 (Body, Validation Plane)

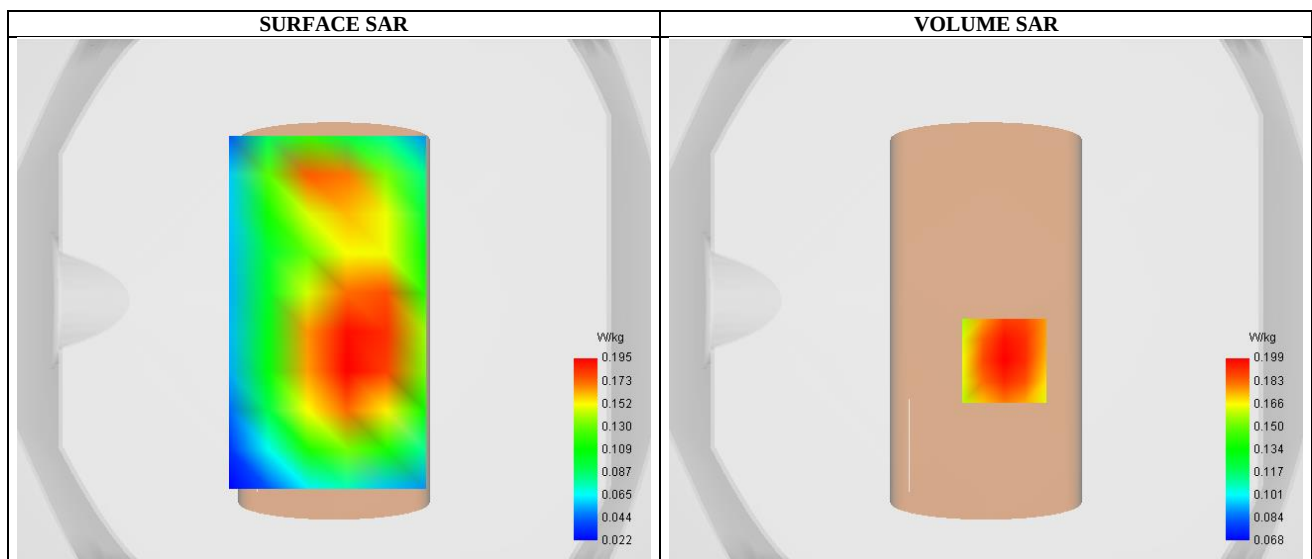
Date of measurement: 22/12/2022

A. Experimental conditions.

Probe	SN 18/21 EPG0354
ConvF	1.73
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Body
Band	Band5_WCDMA850
Channels	Middle
Signal	WCDMA (Crest factor: 1.0)

B. Permittivity

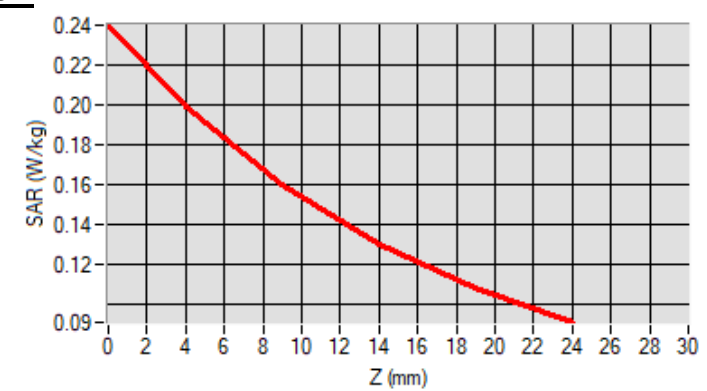
Frequency (MHz)	836.599976
Relative permittivity (real part)	42.366322
Conductivity (S/m)	0.920113

C. SAR Surface and Volume

Maximum location: X=7.00, Y=-23.00 ; SAR Peak: 0.24 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	0.150055
SAR 1g (W/Kg)	0.193189
Variation (%)	-0.860000

E. Z Axis Scan

SAR Measurement at LTE band 2 (Body, Validation Plane)

Date of measurement: 28/12/2022

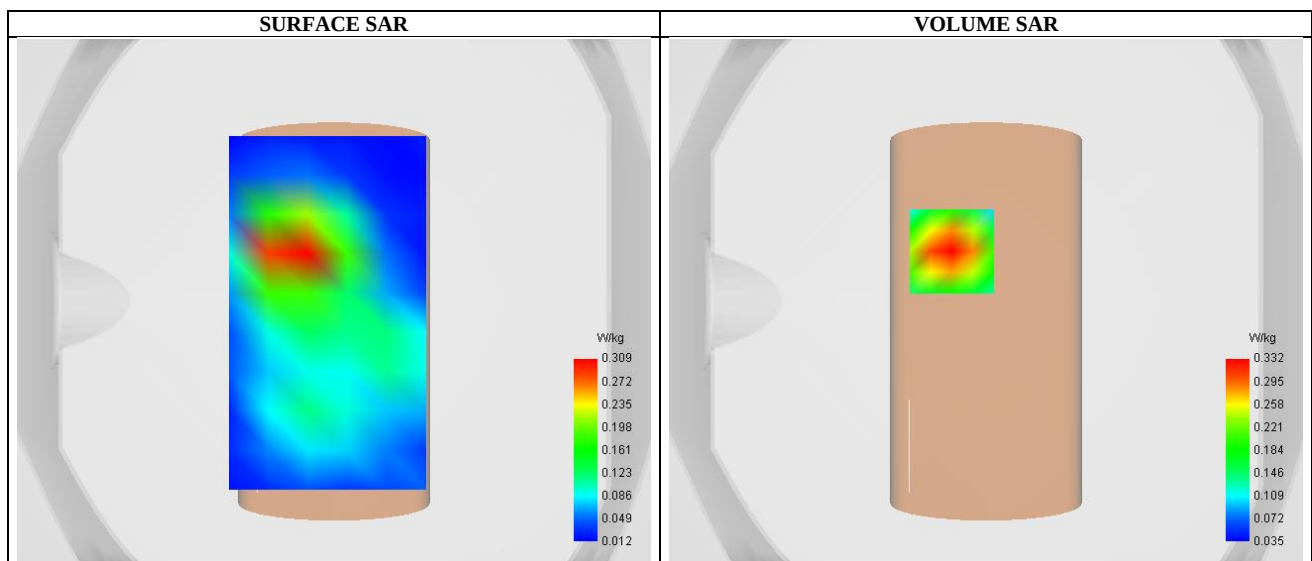
A. Experimental conditions.

Probe	SN 18/21 EPG0354
ConvF	2.00
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Body
Band	LTE band 2
Channels	Low
Signal	LTE (Crest factor: 1.0)

B. Permittivity

Frequency (MHz)	1860.000000
Relative permittivity (real part)	40.059300
Conductivity (S/m)	1.400243

C. SAR Surface and Volume

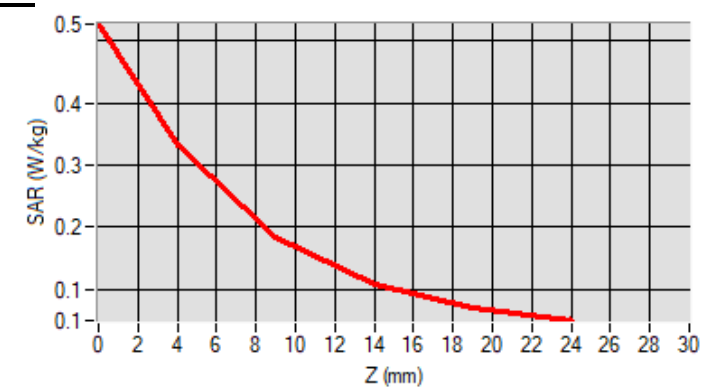


Maximum location: X=-13.00, Y=19.00 ; SAR Peak: 0.53 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	0.177234
SAR 1g (W/Kg)	0.312522
Variation (%)	0.260000

E. Z Axis Scan



SAR Measurement at LTE band 5 (Body, Validation Plane)

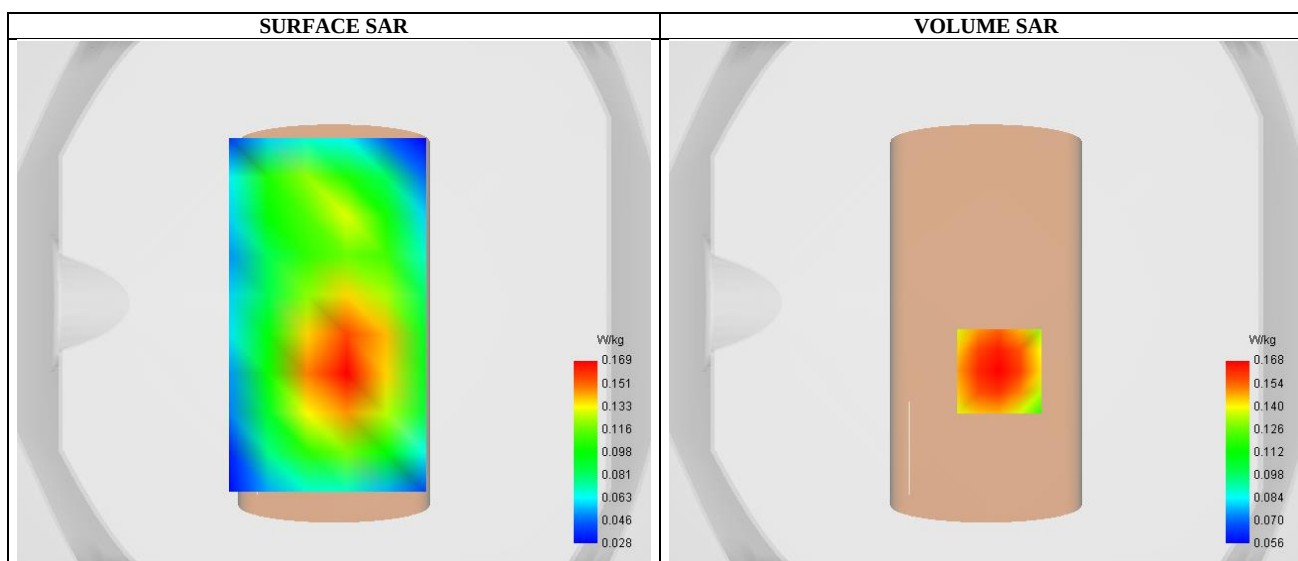
Date of measurement: 22/12/2022

A. Experimental conditions.

Probe	SN 18/21 EPG0354
ConvF	1.73
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Body
Band	LTE band 5
Channels	Low
Signal	LTE (Crest factor: 1.0)

B. Permittivity

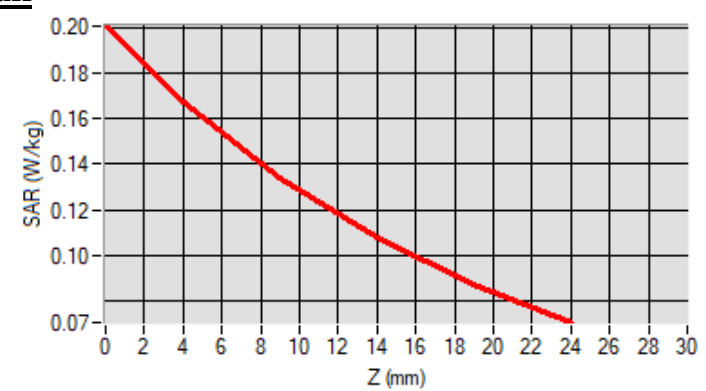
Frequency (MHz)	829.000000
Relative permittivity (real part)	42.123236
Conductivity (S/m)	0.911503

C. SAR Surface and Volume

Maximum location: X=5.00, Y=-26.00 ; SAR Peak: 0.20 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	0.124054
SAR 1g (W/Kg)	0.162264
Variation (%)	-2.280000

E. Z Axis Scan

SAR Measurement at LTE band 12 (Body, Validation Plane)

Date of measurement: 22/12/2022

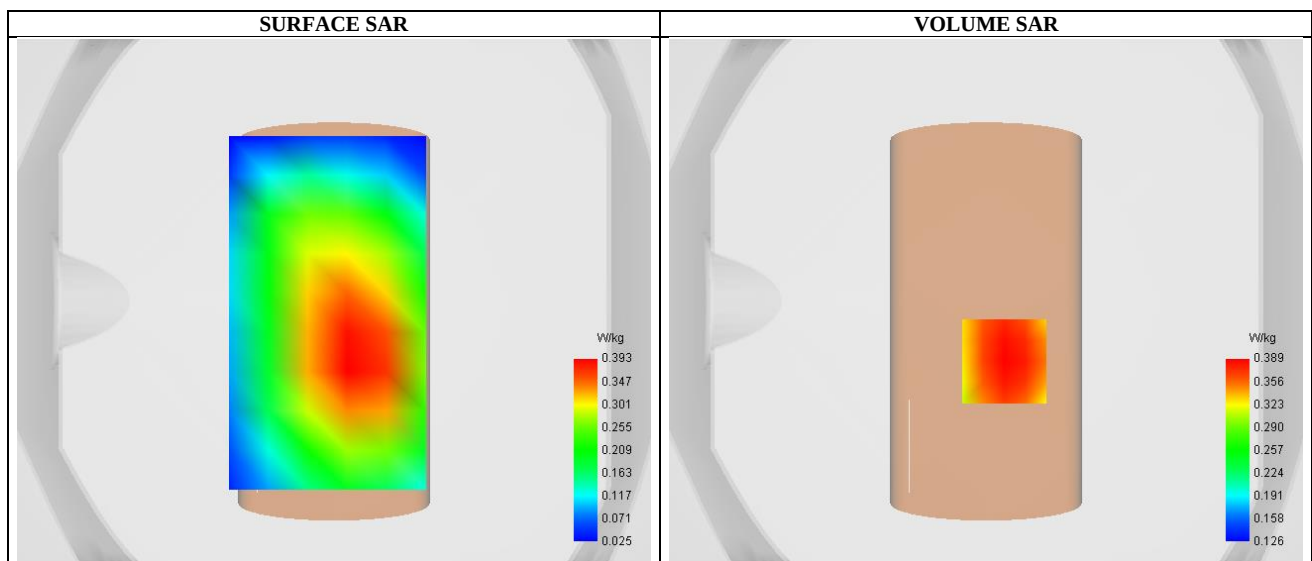
A. Experimental conditions.

Probe	SN 18/21 EPG0354
ConvF	1.70
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Body
Band	LTE band 12
Channels	Low
Signal	LTE (Crest factor: 1.0)

B. Permittivity

Frequency (MHz)	704.000000
Relative permittivity (real part)	42.131332
Conductivity (S/m)	0.891015

C. SAR Surface and Volume

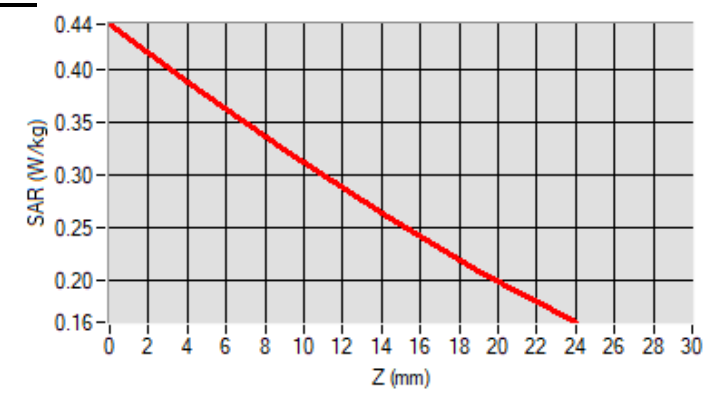


Maximum location: X=7.00, Y=-23.00 ; SAR Peak: 0.45 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	0.300989
SAR 1g (W/Kg)	0.386284
Variation (%)	1.990000

E. Z Axis Scan



SAR Measurement at LTE band 41 (Body, Validation Plane)

Date of measurement: 30/12/2022

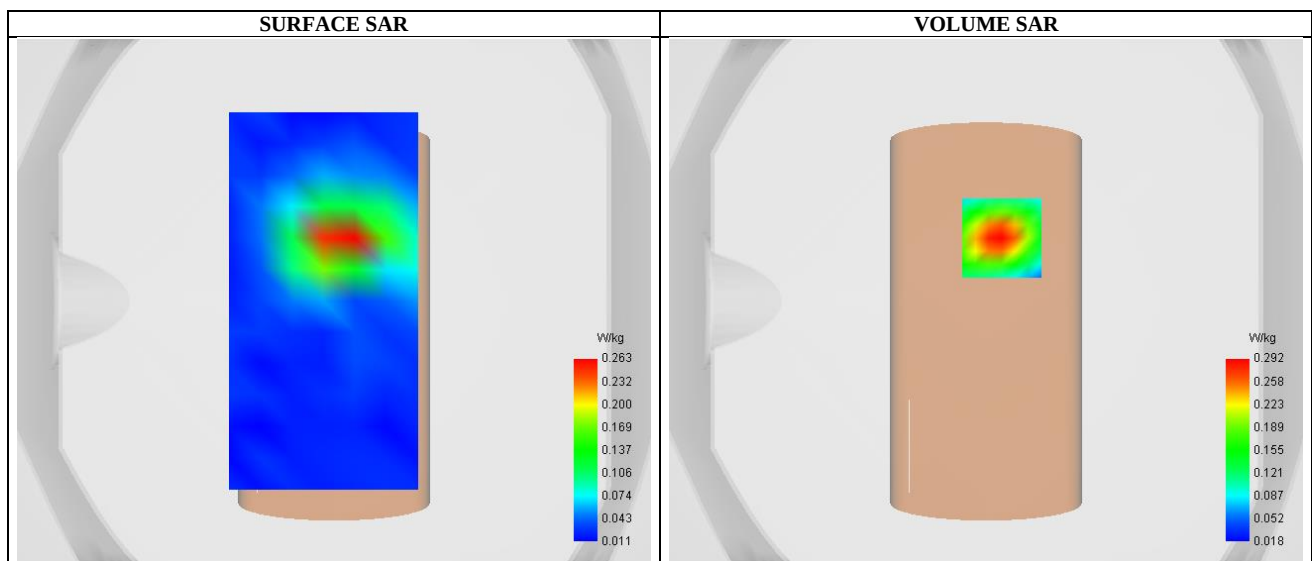
A. Experimental conditions.

Probe	SN 18/21 EPG0354
ConvF	2.27
Area Scan	surf_sam_plan.txt
Zoom Scan	7x7x7,dx=5mm dy=5mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Body
Band	LTE band 41
Channels	Low
Signal	LTE (Crest factor: 1.0)

B. Permittivity

Frequency (MHz)	2565.000000
Relative permittivity (real part)	38.466615
Conductivity (S/m)	1.922007

C. SAR Surface and Volume

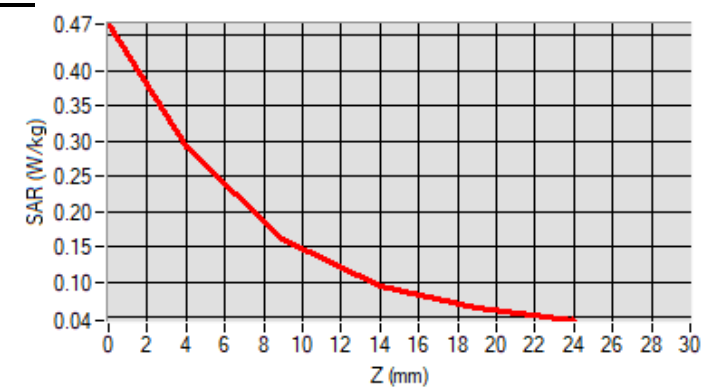


Maximum location: X=6.00, Y=24.00 ; SAR Peak: 0.47 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	0.141524
SAR 1g (W/Kg)	0.265084
Variation (%)	2.400000

E. Z Axis Scan



SAR Measurement at CUSTOM (LTE Band66) (Body, Validation Plane)

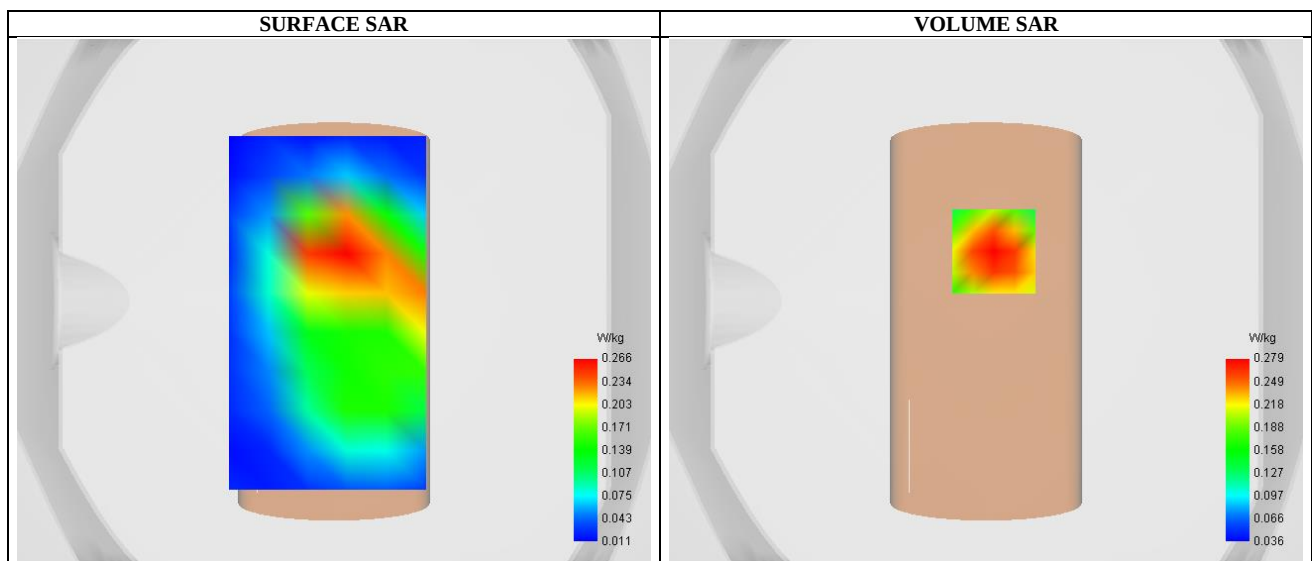
Date of measurement: 28/12/2022

A. Experimental conditions.

Probe	SN 18/21 EPG0354
ConvF	2.05
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Body
Band	LTE band 66
Channels	Low
Signal	LTE (Crest factor: 1.0)

B. Permittivity

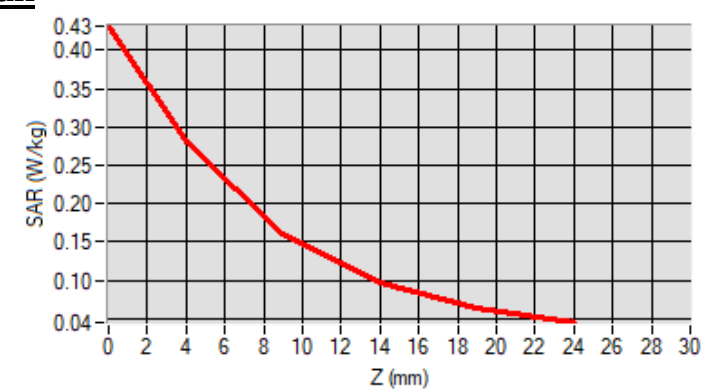
Frequency (MHz)	1720.000000
Relative permittivity (real part)	40.220234
Conductivity (S/m)	1.382335

C. SAR Surface and Volume

Maximum location: X=3.00, Y=19.00 ; SAR Peak: 0.43 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	0.162716
SAR 1g (W/Kg)	0.266086
Variation (%)	0.330000

E. Z Axis Scan

SAR Measurement at CUSTOM (LTE Band 71) (Body, Validation Plane)

Date of measurement: 22/12/2022

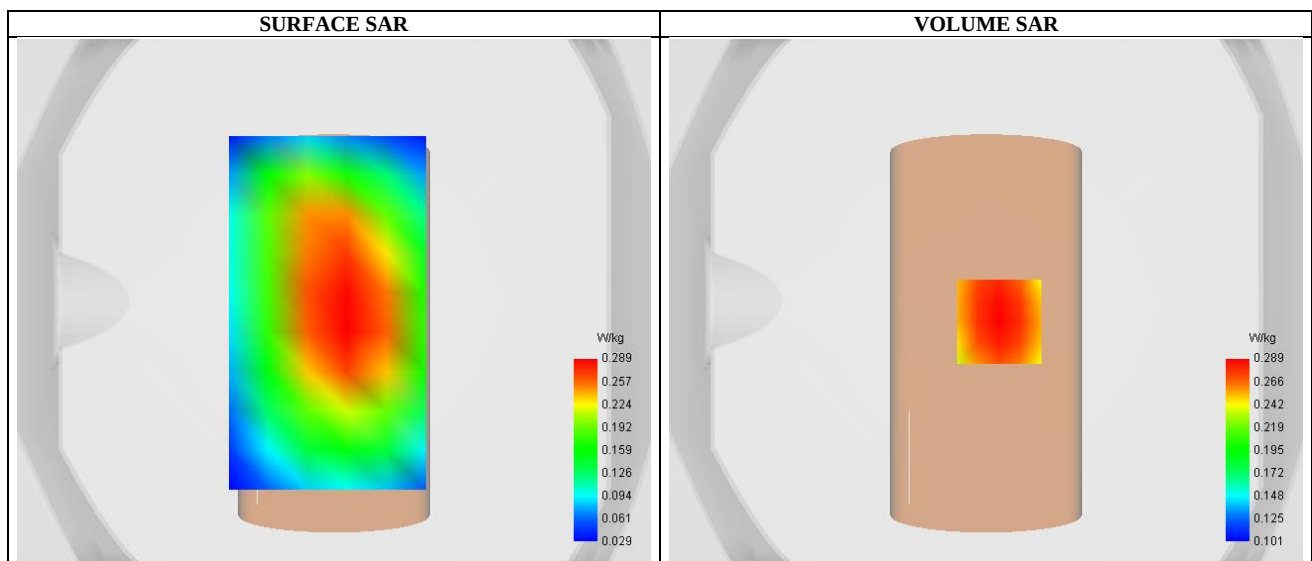
A. Experimental conditions.

Probe	SN 18/21 EPG0354
ConvF	1.70
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Body
Band	LTE band 71
Channels	High
Signal	LTE (Crest factor: 1.0)

B. Permittivity

Frequency (MHz)	688.000000
Relative permittivity (real part)	42.025132
Conductivity (S/m)	0.892437

C. SAR Surface and Volume

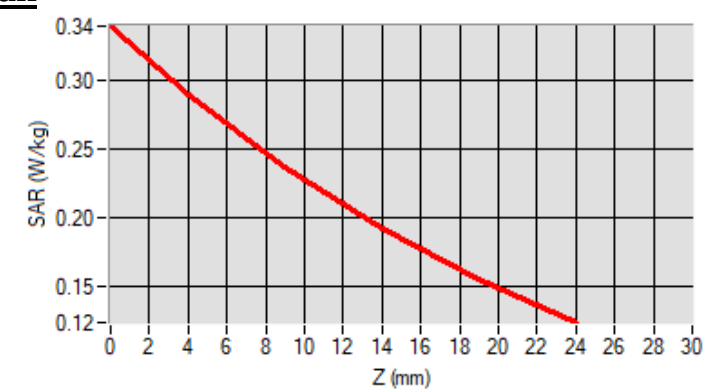


Maximum location: X=5.00, Y=-8.00 ; SAR Peak: 0.34 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	0.224911
SAR 1g (W/Kg)	0.289632
Variation (%)	-2.340000

E. Z Axis Scan



SAR Measurement at IEEE 802.11b ISM (Body, Validation Plane)

Date of measurement: 30/12/2022

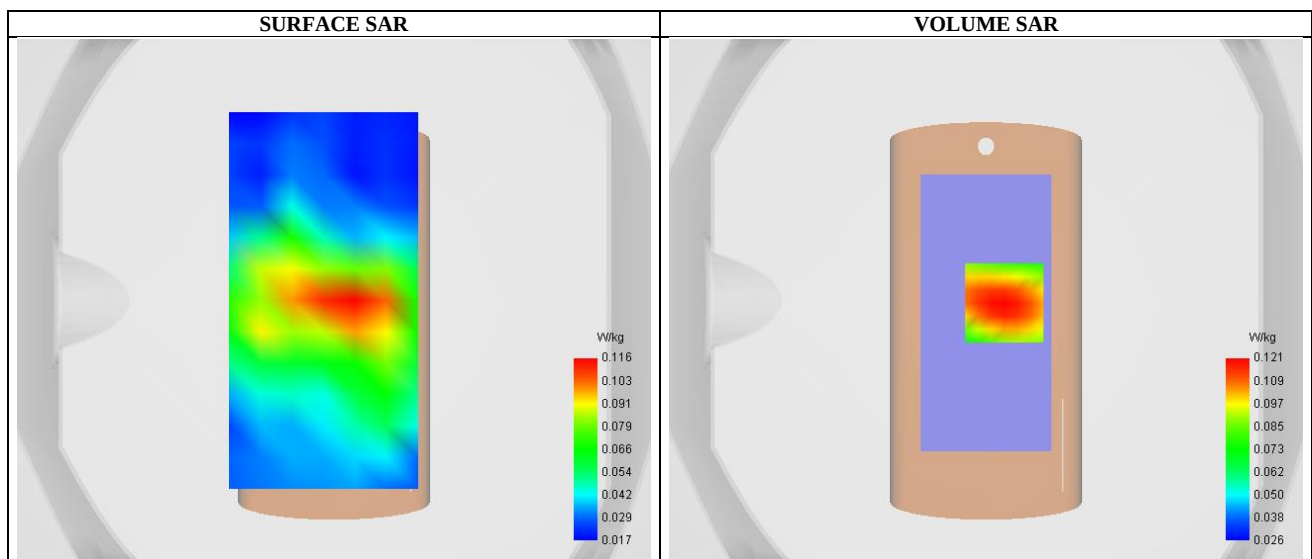
A. Experimental conditions.

Probe	SN 18/21 EPG0354
ConvF	2.46
Area Scan	surf_sam_plan.txt
Zoom Scan	7x7x7,dx=5mm dy=5mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Body
Band	IEEE 802.11b ISM
Channels	Low
Signal	IEEE802.b (Crest factor: 1.0)

B. Permittivity

Frequency (MHz)	2412.000000
Relative permittivity (real part)	39.360021
Conductivity (S/m)	1.796382

C. SAR Surface and Volume

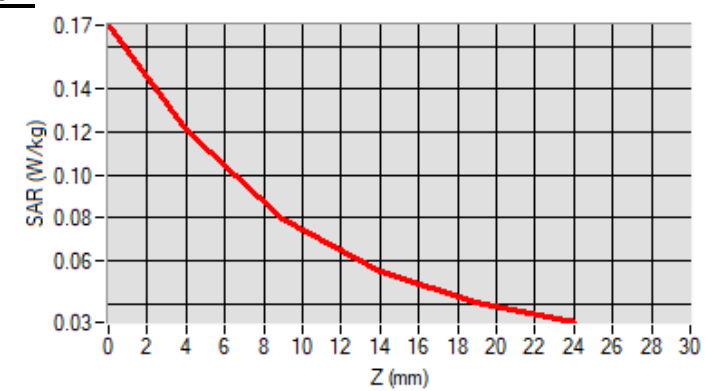


Maximum location: X=7.00, Y=-1.00 ; SAR Peak: 0.17 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	0.076332
SAR 1g (W/Kg)	0.114754
Variation (%)	1.540000

E. Z Axis Scan



SAR Measurement at Bluetooth (Body, Validation Plane)

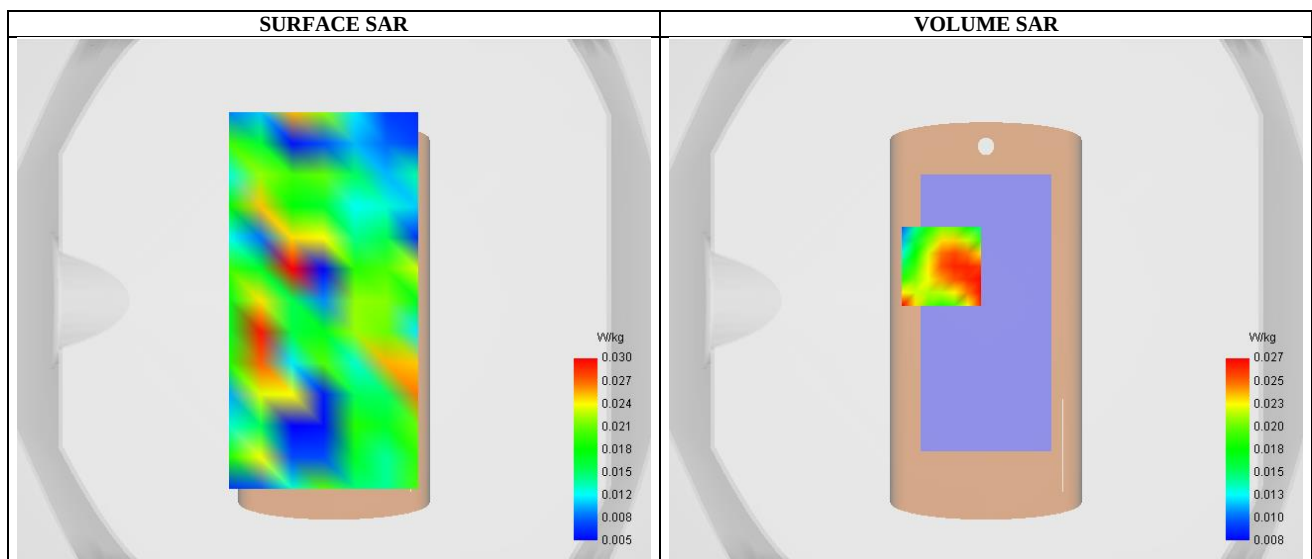
Date of measurement: 30/12/2022

A. Experimental conditions.

Probe	SN 18/21 EPG0354
ConvF	2.46
Area Scan	surf_sam_plan.txt
Zoom Scan	7x7x7,dx=5mm dy=5mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Body
Band	Bluetooth
Channels	Middle
Signal	Bluetooth (Crest factor: 1.0)

B. Permittivity

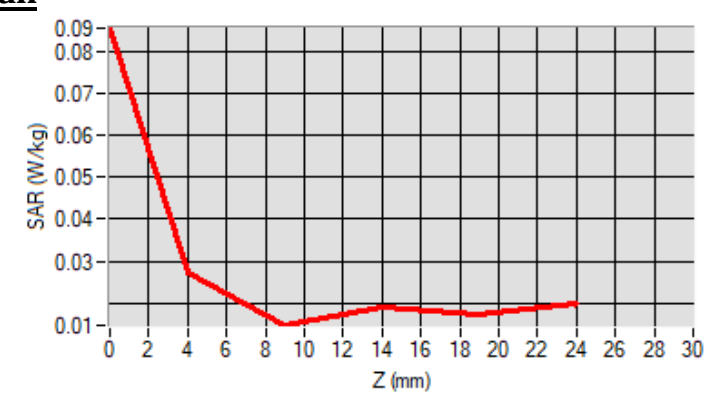
Frequency (MHz)	2441.000000
Relative permittivity (real part)	39.202000
Conductivity (S/m)	1.791220

C. SAR Surface and Volume

Maximum location: X=-17.00, Y=13.00 ; SAR Peak: 0.04 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	0.017704
SAR 1g (W/Kg)	0.025285
Variation (%)	-2.500000

E. Z Axis Scan

SAR Measurement at CUSTOM (BLE_1M) (Body, Validation Plane)

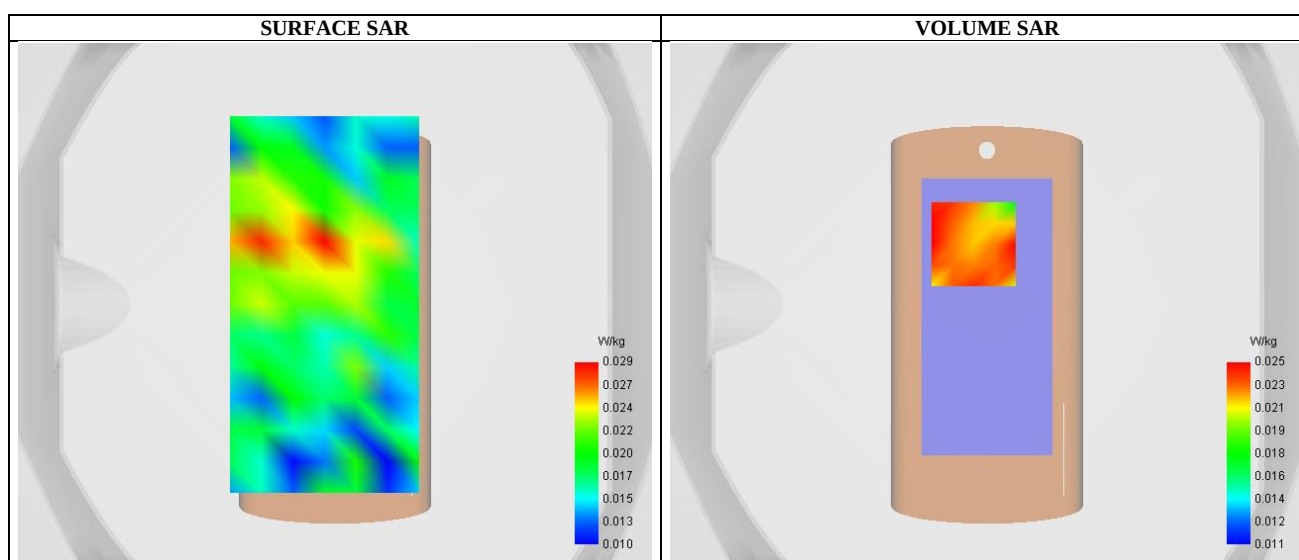
Date of measurement: 30/12/2022

A. Experimental conditions.

Probe	SN 18/21 EPG0354
ConvF	2.46
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=5mm dy=5mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Body
Band	BLE
Channels	Middle
Signal	BLE (Crest factor: 1.0)

B. Permittivity

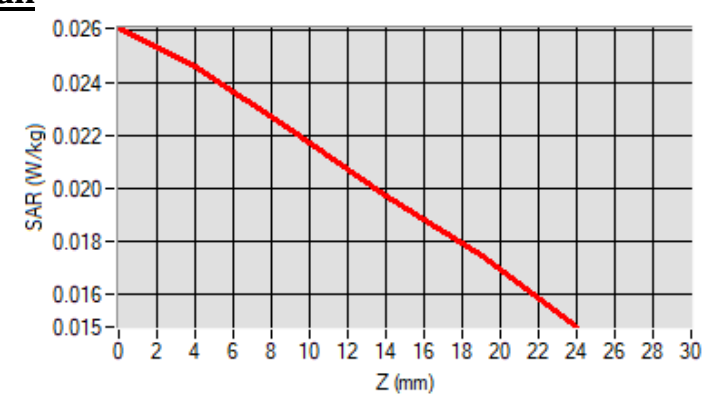
Frequency (MHz)	2442.000000
Relative permittivity (real part)	39.216000
Conductivity (S/m)	1.792223

C. SAR Surface and Volume

Maximum location: X=-5.00, Y=23.00 ; SAR Peak: 0.03 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	0.019839
SAR 1g (W/Kg)	0.023772
Variation (%)	-0.750000

E. Z Axis Scan

SAR Measurement at Band2_WCDMA1900 (Body, Validation Plane)

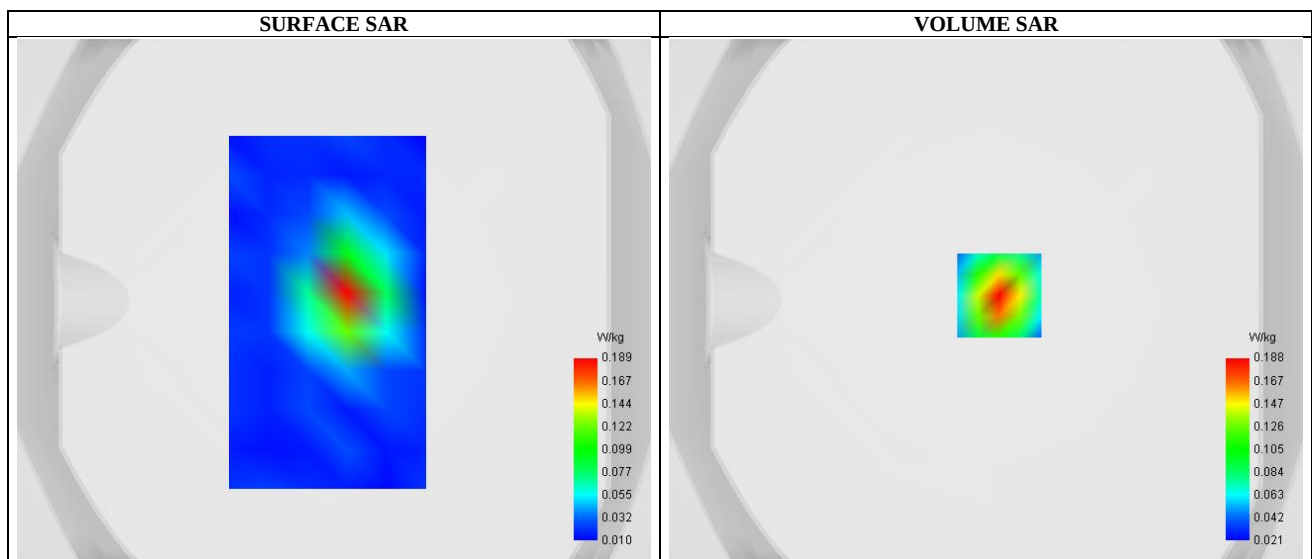
Date of measurement: 28/12/2022

A. Experimental conditions.

Probe	SN 18/21 EPG0354
ConvF	2.00
Area Scan	surf_sam_plan.txt
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Body
Band	Band2_WCDMA1900
Channels	Low
Signal	WCDMA (Crest factor: 1.0)

B. Permittivity

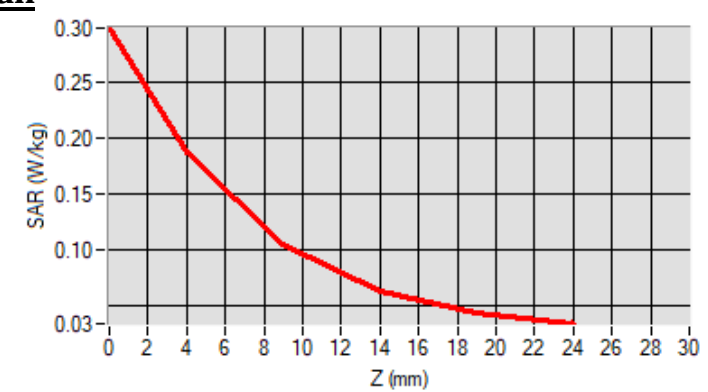
Frequency (MHz)	1852.400024
Relative permittivity (real part)	40.110000
Conductivity (S/m)	1.400011

C. SAR Surface and Volume

Maximum location: X=5.00, Y=2.00 ; SAR Peak: 0.30 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	0.093966
SAR 1g (W/Kg)	0.174472
Variation (%)	0.170000

E. Z Axis Scan

SAR Measurement at LTE band 41 (Body, Validation Plane)

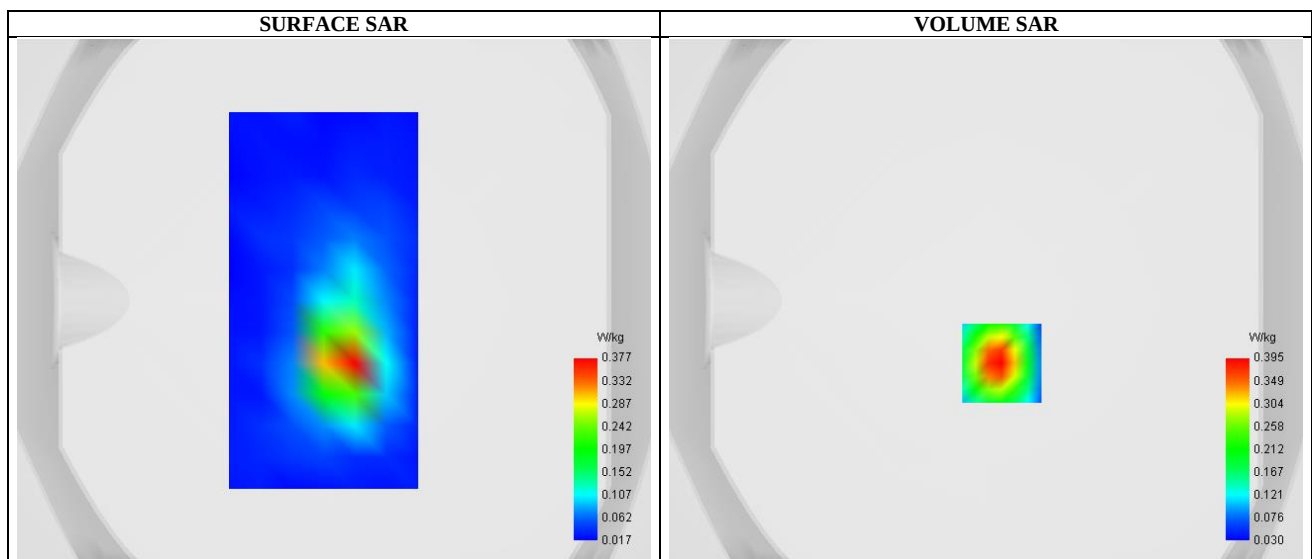
Date of measurement: 12/30/2022

A. Experimental conditions.

Probe	SN 18/21 EPG0354
ConvF	2.27
Area Scan	surf_sam_plan.txt
Zoom Scan	7x7x7,dx=5mm dy=5mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Body
Band	LTE band 41
Channels	Low
Signal	LTE (Crest factor: 1.0)

B. Permittivity

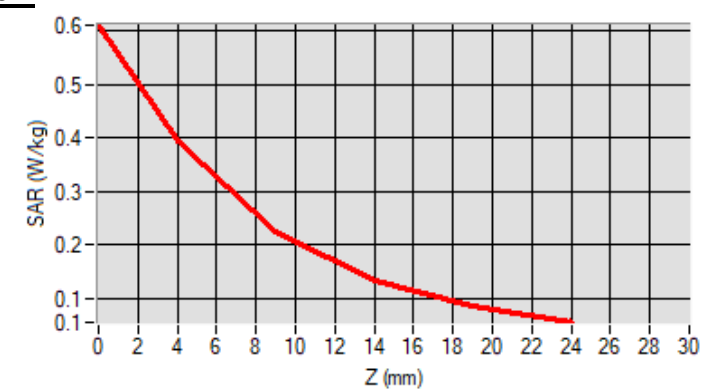
Frequency (MHz)	2565.000000
Relative permittivity (real part)	38.466615
Conductivity (S/m)	1.922007

C. SAR Surface and Volume

Maximum location: X=6.00, Y=-24.00 ; SAR Peak: 0.62 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	0.189099
SAR 1g (W/Kg)	0.357547
Variation (%)	0.390000

E. Z Axis Scan

SAR Measurement at LTE band 41 (Body, Validation Plane)

Date of measurement: 30/12/2022

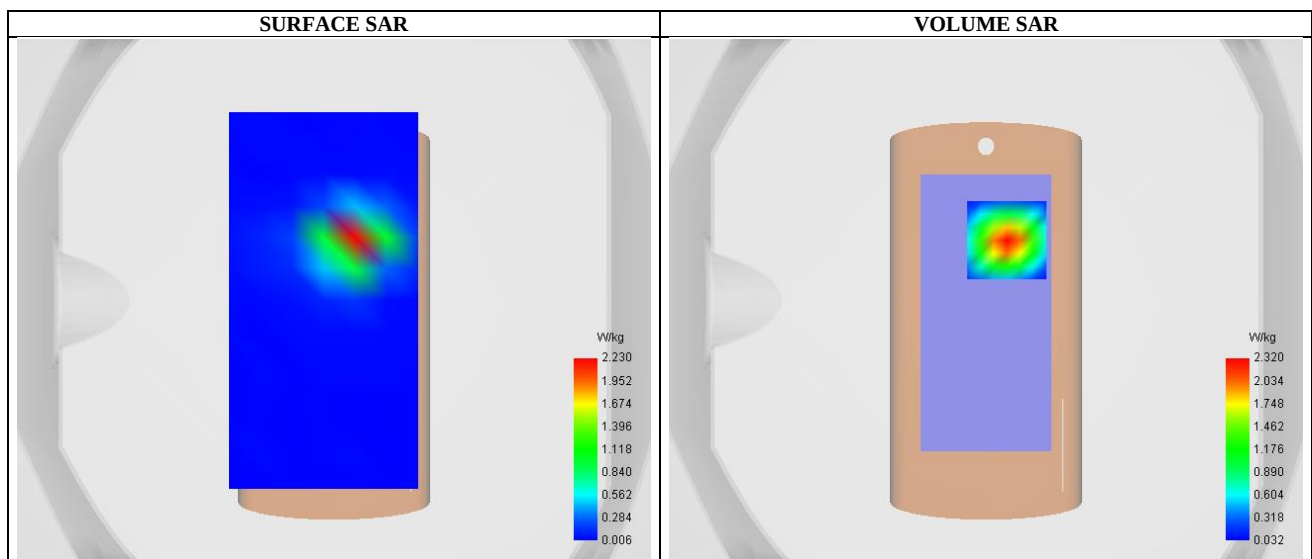
A. Experimental conditions.

Probe	SN 18/21 EPG0354
ConvF	2.27
Area Scan	surf_sam_plan.txt
Zoom Scan	7x7x7,dx=5mm dy=5mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Body
Band	LTE band 41
Channels	Middle
Signal	LTE (Crest factor: 1.0)

B. Permittivity

Frequency (MHz)	2605.000000
Relative permittivity (real part)	38.675323
Conductivity (S/m)	1.933482

C. SAR Surface and Volume

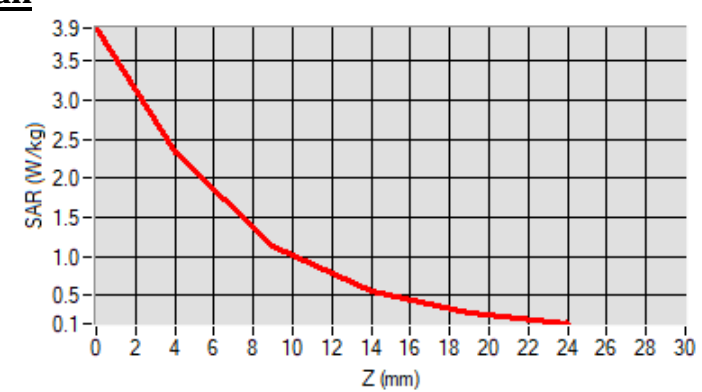


Maximum location: X=8.00, Y=23.00 ; SAR Peak: 3.92 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	0.862801
SAR 1g (W/Kg)	1.998964
Variation (%)	0.530000

E. Z Axis Scan



SAR Measurement at LTE band 41 (Body, Validation Plane)

Date of measurement: 30/12/2022

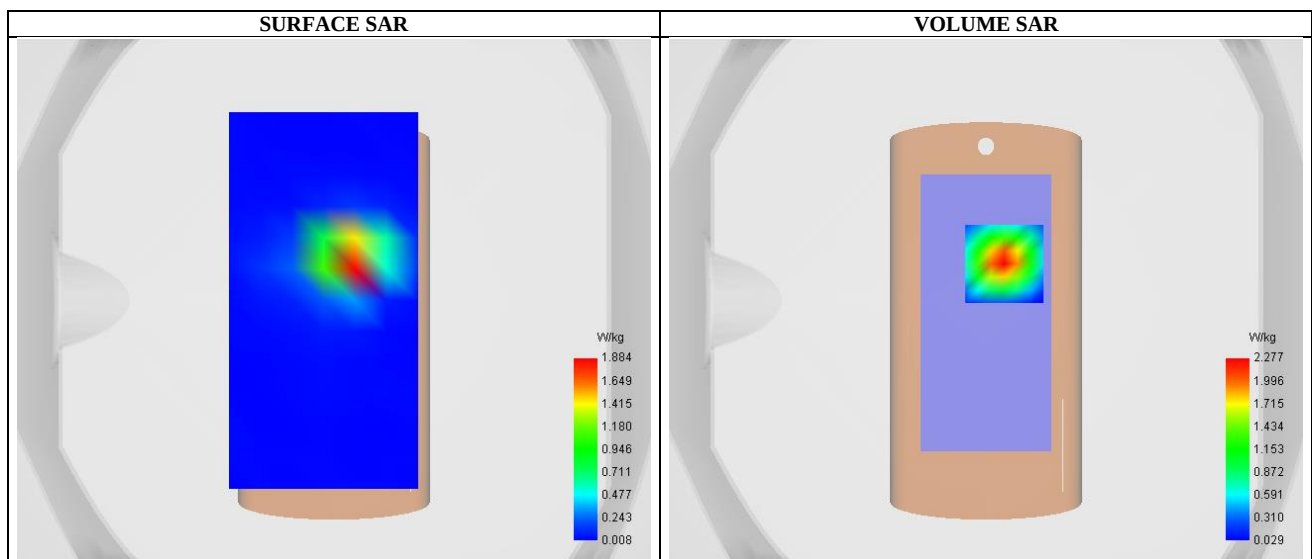
A. Experimental conditions.

Probe	SN 18/21 EPG0354
ConvF	2.27
Area Scan	surf_sam_plan.txt
Zoom Scan	7x7x7,dx=5mm dy=5mm dz=5mm,Complete
Phantom	Validation plane
Device Position	Body
Band	LTE band 41
Channels	Middle
Signal	LTE (Crest factor: 1.0)

B. Permittivity

Frequency (MHz)	2605.000000
Relative permittivity (real part)	38.675323
Conductivity (S/m)	1.933482

C. SAR Surface and Volume

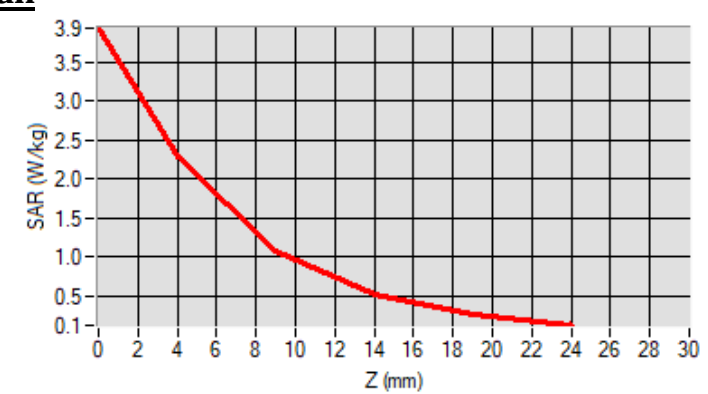


Maximum location: X=7.00, Y=14.00 ; SAR Peak: 3.93 W/kg

D. SAR 1g & 10g

SAR 10g (W/Kg)	0.852605
SAR 1g (W/Kg)	1.983406
Variation (%)	-0.620000

E. Z Axis Scan



Appendix C: System Calibration Certificate

Calibration information for E-field probes



COMOSAR E-Field Probe Calibration Report

Ref : ACR.140.1.21.BES.B

Cancel and replace the report ACR.140.1.21.BES.A

**JIANYAN TESTING GROUP SHENZHEN
CO.,LTD.**
NO.101, BUILDING 8, INNOVATION WISDOM PORT, NO.155
HONGTIAN ROAD, HUANGPU COMMUNITY, XINQIAO
STREET,
BAO'AN DISTRICT, SHENZHEN, GUANGDONG, CHINA
MVG COMOSAR DOSIMETRIC E-FIELD PROBE
SERIAL NO.: SN 18/21 EPG0354

Calibrated at MVG
Z.I. de la pointe du diable
Technopôle Brest Iroise – 295 avenue Alexis de Rochon
29280 PLOUZANE - FRANCE

Calibration date: 05/20/2021

Accreditations #2-6789 and #2-6814
Scope available on www.cofrac.fr

Summary:
This document presents the method and results from an accredited COMOSAR 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.140.1.21.BES.B

	<i>Name</i>	<i>Function</i>	<i>Date</i>	<i>Signature</i>
<i>Prepared by :</i>	Jérôme Luc	Technical Manager	5/20/2021	
<i>Checked by :</i>	Jérôme Luc	Technical Manager	5/20/2021	
<i>Approved by :</i>	Yann Toutain	Laboratory Director	5/21/2021	

	<i>Customer Name</i>
<i>Distribution :</i>	JIANYAN TESTING GROUP SHENZHEN CO.,LTD.

<i>Issue</i>	<i>Name</i>	<i>Date</i>	<i>Modifications</i>
A	Jérôme Luc	5/20/2021	Initial release
B	Jérôme Luc	5/21/2021	Change customer address Add picture 1 Add 1450 MHz calibration

Page: 2/10

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COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.140.1.21.BES.B

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1 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR DOSIMETRIC E FIELD PROBE
Manufacturer	MVG
Model	SSE2
Serial Number	SN 18/21 EPGO354
Product Condition (new / used)	New
Frequency Range of Probe	0.15 GHz-6GHz
Resistance of Three Dipoles at Connector	Dipole 1: R1=0.202 MΩ Dipole 2: R2=0.217 MΩ Dipole 3: R3=0.225 MΩ

2 PRODUCT DESCRIPTION

2.1 GENERAL INFORMATION

MVG's COMOSAR E field Probes are built in accordance to the IEEE 1528, FCC KDB865664 D01, CENELEC EN62209 and CEI/IEC 62209 standards.



Figure 1 – MVG COMOSAR Dosimetric E field Dipole

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 IEEE 1528, FCC KDB865664 D01, CENELEC EN62209 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.

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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 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:

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

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.

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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 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 (%)
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 ($\mu\text{V}/(\text{V}/\text{m})^2$)
0.86	0.87	0.90

DCP dipole 1 (mV)	DCP dipole 2 (mV)	DCP dipole 3 (mV)
107	101	105

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

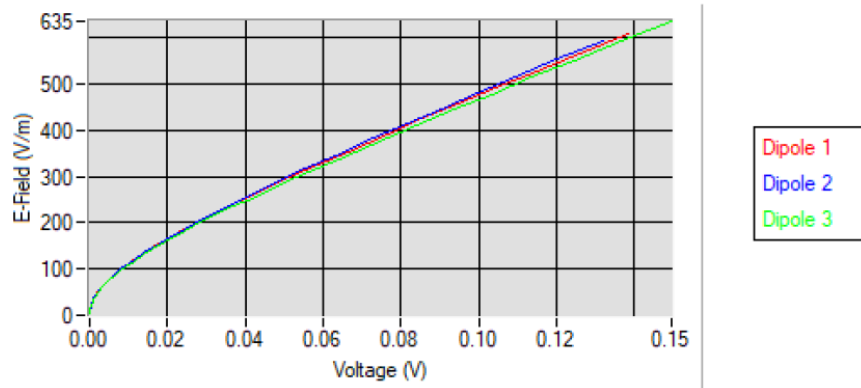
$$E = \sqrt{E_1^2 + E_2^2 + E_3^2}$$



COMOSAR E-FIELD PROBE CALIBRATION REPORT

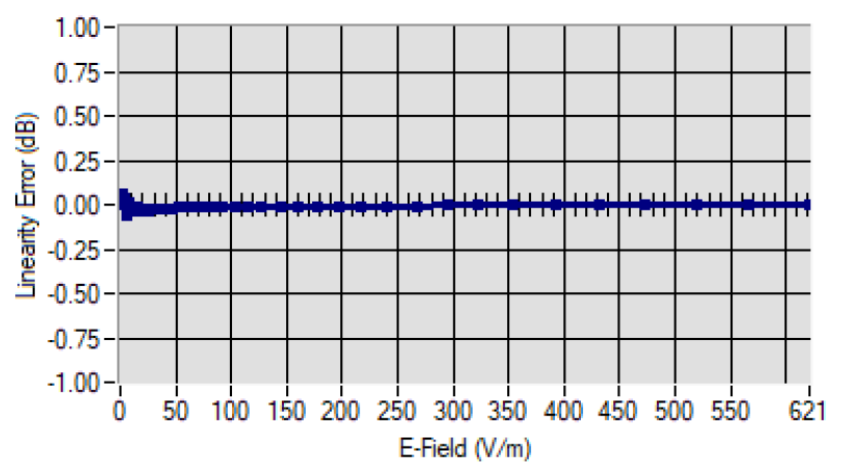
Ref: ACR.140.1.21.BES.B

Calibration curves



5.2 LINEARITY

Linearity



Linearity: +/- 1.55% (+/- 0.07dB)



COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.140.1.21.BES.B

5.3 SENSITIVITY IN LIQUID

Liquid	Frequency (MHz +/- 100MHz)	ConvF
HL450*	450	1.92
BL450*	450	1.87
HL750	750	1.73
BL750	750	1.81
HL850	835	1.68
BL850	835	1.82
HL900	900	1.88
BL900	900	1.92
HL1450	1450	2.25
BL1450	1450	2.54
HL1750	1750	2.07
BL1750	1750	2.20
HL1900	1900	2.14
BL1900	1900	2.23
HL2100	2100	2.09
BL2100	2100	2.27
HL2300	2300	2.23
BL2300	2300	2.48
HL2450	2450	2.23
BL2450	2450	2.58
HL2600	2600	2.15
BL2600	2600	2.38
HL3300	3300	2.02
BL3300	3300	2.19
HL3500	3500	2.11
BL3500	3500	2.29
HL3700	3700	2.13
BL3700	3700	2.28
HL3900	3900	2.26
BL3900	3900	2.48
HL4200	4200	2.58
BL4200	4200	2.63
HL4600	4600	2.44
BL4600	4600	2.60
HL4900	4900	2.34
BL4900	4900	2.32
HL5200	5200	1.86
BL5200	5200	1.75
HL5400	5400	2.07
BL5400	5400	1.94
HL5600	5600	2.20
BL5600	5600	2.11
HL5800	5800	2.07
BL5800	5800	1.99

* Frequency not cover by COFRAC scope, calibration not accredited

LOWER DETECTION LIMIT: 8mW/kg

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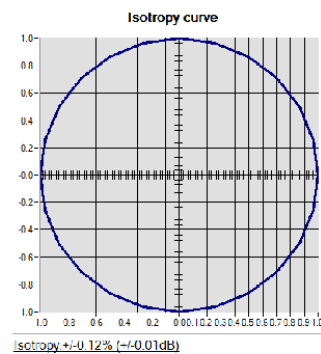


COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.140.1.21.BES.B

5.4 ISOTROPY

HL1900 MHz





COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.140.1.21.BES.B

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	Rohde & Schwarz ZVM	100203	05/2019	05/2022
Network Analyzer – Calibration kit	Rohde & Schwarz ZV-Z235	101223	05/2019	05/2022
Multimeter	Keithley 2000	1160271	02/2020	02/2023
Signal Generator	Rohde & Schwarz SMB	106589	04/2019	04/2022
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	NI-USB 5680	170100013	05/2019	05/2022
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	Testo 184 H1	44220687	05/2020	05/2023

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Calibration information for Dipole



SAR Reference Dipole Calibration Report

Ref : ACR.15.5.21.MVGB.B

Cancel and replace the report ACR.15.5.21.MVGB.A

**JIANYAN TESTING GROUP
SHENZHEN CO.,LTD.**

**No.110~116, BUILDING B, JINYUAN BUSINESS BUILDING,
XIXIANG ROAD, BAOAN DISTRICT,
SHENZHEN, GUANGDONG, PR CHINA**

MVG COMOSAR REFERENCE DIPOLE

FREQUENCY: 750 MHZ

SERIAL NO.: SN 50/20 DIP 0G750-506

Calibrated at MVG

Z.I. de la pointe du diable

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

Calibration date: 01/14/2021



Accreditations #2-6789 and #2-6814
Scope available on www.cofrac.fr

Summary:

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



SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.15.5.21.MVGB.B

	<i>Name</i>	<i>Function</i>	<i>Date</i>	<i>Signature</i>
<i>Prepared by :</i>	Jérôme LUC	Technical Manager	1/15/2021	<i>JES</i>
<i>Checked by :</i>	Jérôme LUC	Technical Manager	1/15/2021	<i>JES</i>
<i>Approved by :</i>	Yann Toutain	Laboratory Director	2/8/2021	<i>Yann Toutain</i>

2021.02.0
8 17:46:38
+01'00'

	<i>Customer Name</i>
<i>Distribution :</i>	JianYan Testing Group Shenzhen Co.,Ltd.

<i>Issue</i>	<i>Name</i>	<i>Date</i>	<i>Modifications</i>
A	Jérôme LUC	1/15/2021	Initial release
B	Jérôme LUC	2/8/2021	Change customer name/address

Page: 2/13

Template_ACR.DDD.N.YY.MVGB.ISSUE_SAR Reference Dipole vG

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.15.5.21.MVGB.B

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 50/20 DIP 0G750-506
Product Condition (new / used)	New

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

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



Figure 1 – MVG COMOSAR Validation Dipole

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4 MEASUREMENT METHOD

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

4.1 RETURN LOSS REQUIREMENTS

The dipole used for SAR system validation measurements and checks must have a return loss of -20 dB or better. The return loss measurement shall be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. A direct method is used with a network analyser and its calibration kit, both with a valid ISO17025 calibration.

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 dimension's 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. A direct method is used with a ISO17025 calibrated caliper.

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	0.08 LIN

5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

Length (mm)	Expanded Uncertainty on Length
0 - 300	0.20 mm
300 - 450	0.44 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.



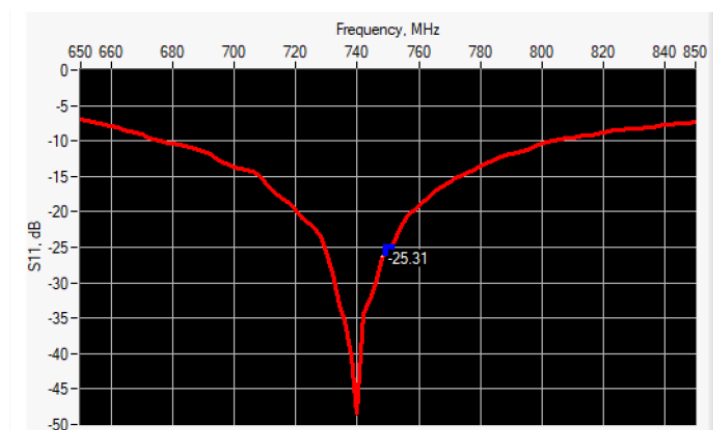
SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.15.5.21.MVGB.B

Scan Volume	Expanded Uncertainty
1 g	19 % (SAR)
10 g	19 % (SAR)

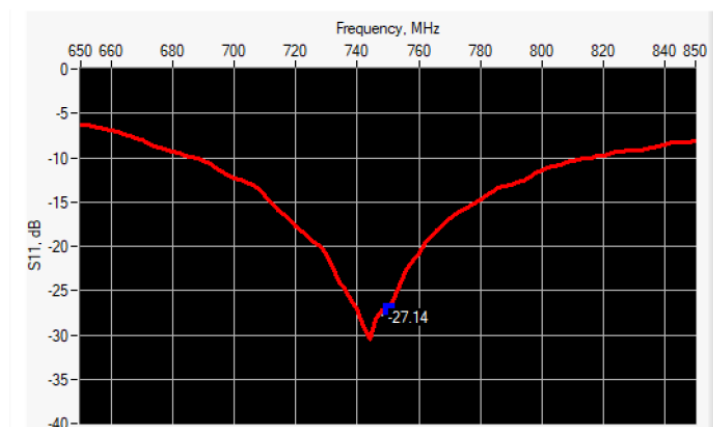
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
750	-25.31	-20	$54.0 \Omega - 3.7 j\Omega$

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
750	-27.14	-20	$54.2 \Omega + 1.4 j\Omega$

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.15.5.21.MVGB.B

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 %.	
450	290.0 ±1 %.		166.7 ±1 %.		6.35 ±1 %.	
750	176.0 ±1 %.	177.03	100.0 ±1 %.	100.34	6.35 ±1 %.	6.35
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 %.	
3300	-		-		-	
3500	37.0±1 %.		26.4 ±1 %.		3.6 ±1 %.	
3700	34.7±1 %.		26.4 ±1 %.		3.6 ±1 %.	
3900	-		-		-	
4200	-		-		-	
4600	-		-		-	
4900	-		-		-	

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.

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.15.5.21.MVGB.B

7.1 HEAD LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ϵ_r)		Conductivity (σ) S/m	
	required	measured	required	measured
300	45.3 $\pm$ 10 %		0.87 $\pm$ 10 %	
450	43.5 $\pm$ 10 %		0.87 $\pm$ 10 %	
750	41.9 $\pm$ 10 %	41.8	0.89 $\pm$ 10 %	0.82
835	41.5 $\pm$ 10 %		0.90 $\pm$ 10 %	
900	41.5 $\pm$ 10 %		0.97 $\pm$ 10 %	
1450	40.5 $\pm$ 10 %		1.20 $\pm$ 10 %	
1500	40.4 $\pm$ 10 %		1.23 $\pm$ 10 %	
1640	40.2 $\pm$ 10 %		1.31 $\pm$ 10 %	
1750	40.1 $\pm$ 10 %		1.37 $\pm$ 10 %	
1800	40.0 $\pm$ 10 %		1.40 $\pm$ 10 %	
1900	40.0 $\pm$ 10 %		1.40 $\pm$ 10 %	
1950	40.0 $\pm$ 10 %		1.40 $\pm$ 10 %	
2000	40.0 $\pm$ 10 %		1.40 $\pm$ 10 %	
2100	39.8 $\pm$ 10 %		1.49 $\pm$ 10 %	
2300	39.5 $\pm$ 10 %		1.67 $\pm$ 10 %	
2450	39.2 $\pm$ 10 %		1.80 $\pm$ 10 %	
2600	39.0 $\pm$ 10 %		1.96 $\pm$ 10 %	
3000	38.5 $\pm$ 10 %		2.40 $\pm$ 10 %	
3300	38.2 $\pm$ 10 %		2.71 $\pm$ 10 %	
3500	37.9 $\pm$ 10 %		2.91 $\pm$ 10 %	
3700	37.7 $\pm$ 10 %		3.12 $\pm$ 10 %	
3900	37.5 $\pm$ 10 %		3.32 $\pm$ 10 %	
4200	37.1 $\pm$ 10 %		3.63 $\pm$ 10 %	
4600	36.7 $\pm$ 10 %		4.04 $\pm$ 10 %	
4900	36.3 $\pm$ 10 %		4.35 $\pm$ 10 %	

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.

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.15.5.21.MVGB.B

Software	OPENSAR V5
Phantom	SN 13/09 SAM68
Probe	SN 41/18 EPG0333
Liquid	Head Liquid Values: ϵ_p : 41.8 σ : 0.82
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	20 +/- 1 °C
Lab Temperature	20 +/- 1 °C
Lab Humidity	30-70 %

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	8.57 (0.86)	5.55	5.56 (0.56)
835	9.56		6.22	
900	10.9		6.99	
1450	29		16	
1500	30.5		16.8	
1640	34.2		18.4	
1750	36.4		19.3	
1800	38.4		20.1	
1900	39.7		20.5	
1950	40.5		20.9	
2000	41.1		21.1	
2100	43.6		21.9	
2300	48.7		23.3	
2450	52.4		24	
2600	55.3		24.6	
3000	63.8		25.7	
3300	-		-	
3500	67.1		25	
3700	67.4		24.2	
3900	-		-	
4200	-		-	
4600	-		-	
4900	-		-	

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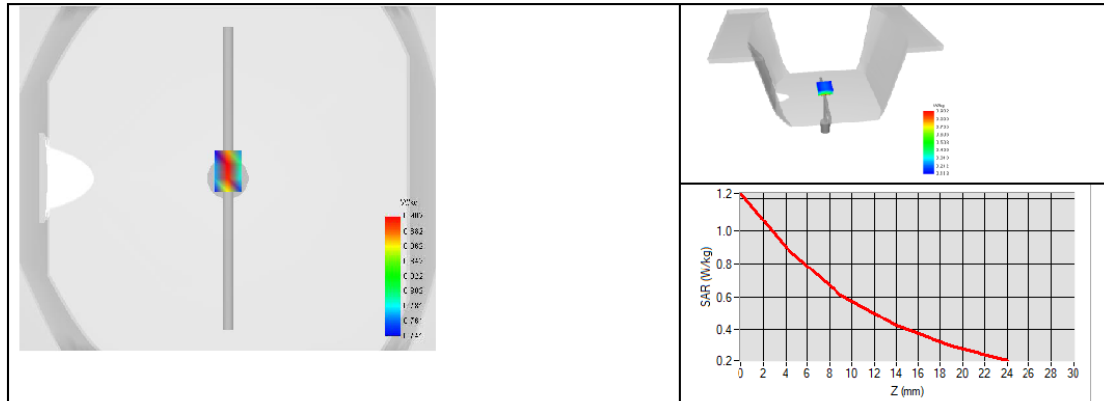
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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.15.5.21.MVGB.B

7.3 BODY LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ϵ_r')		Conductivity (σ) S/m	
	required	measured	required	measured
150	61.9 $\pm$ 10 %		0.80 $\pm$ 10 %	
300	58.2 $\pm$ 10 %		0.92 $\pm$ 10 %	
450	56.7 $\pm$ 10 %		0.94 $\pm$ 10 %	
750	55.5 $\pm$ 10 %	52.9	0.96 $\pm$ 10 %	0.89
835	55.2 $\pm$ 10 %		0.97 $\pm$ 10 %	
900	55.0 $\pm$ 10 %		1.05 $\pm$ 10 %	
915	55.0 $\pm$ 10 %		1.06 $\pm$ 10 %	
1450	54.0 $\pm$ 10 %		1.30 $\pm$ 10 %	
1610	53.8 $\pm$ 10 %		1.40 $\pm$ 10 %	
1800	53.3 $\pm$ 10 %		1.52 $\pm$ 10 %	
1900	53.3 $\pm$ 10 %		1.52 $\pm$ 10 %	
2000	53.3 $\pm$ 10 %		1.52 $\pm$ 10 %	
2100	53.2 $\pm$ 10 %		1.62 $\pm$ 10 %	
2300	52.9 $\pm$ 10 %		1.81 $\pm$ 10 %	
2450	52.7 $\pm$ 10 %		1.95 $\pm$ 10 %	
2600	52.5 $\pm$ 10 %		2.16 $\pm$ 10 %	
3000	52.0 $\pm$ 10 %		2.73 $\pm$ 10 %	
3300	51.6 $\pm$ 10 %		3.08 $\pm$ 10 %	
3500	51.3 $\pm$ 10 %		3.31 $\pm$ 10 %	
3700	51.0 $\pm$ 10 %		3.55 $\pm$ 10 %	
3900	50.8 $\pm$ 10 %		3.78 $\pm$ 10 %	
4200	50.4 $\pm$ 10 %		4.13 $\pm$ 10 %	
4600	49.8 $\pm$ 10 %		4.60 $\pm$ 10 %	
4900	49.4 $\pm$ 10 %		4.95 $\pm$ 10 %	
5200	49.0 $\pm$ 10 %		5.30 $\pm$ 10 %	
5300	48.9 $\pm$ 10 %		5.42 $\pm$ 10 %	
5400	48.7 $\pm$ 10 %		5.53 $\pm$ 10 %	
5500	48.6 $\pm$ 10 %		5.65 $\pm$ 10 %	
5600	48.5 $\pm$ 10 %		5.77 $\pm$ 10 %	
5800	48.2 $\pm$ 10 %		6.00 $\pm$ 10 %	

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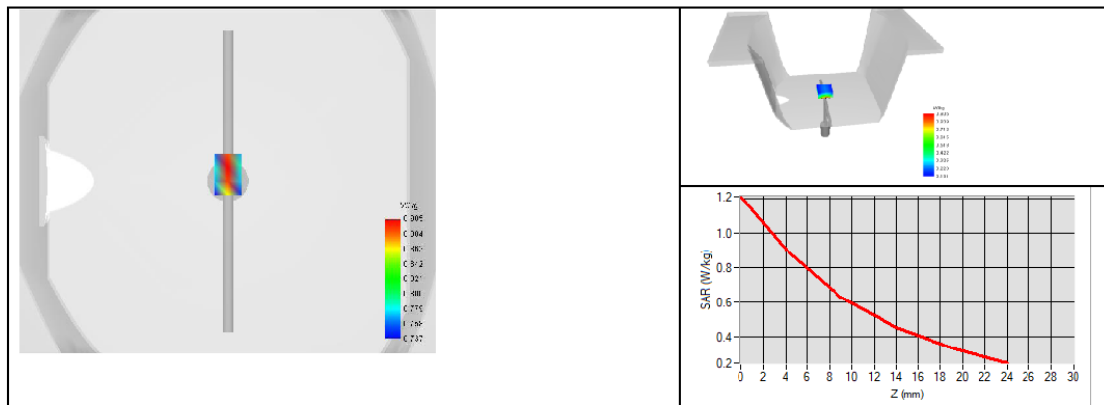
SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.15.5.21.MVGB.B

7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

Software	OPENSAR V5
Phantom	SN 13/09 SAM68
Probe	SN 41/18 EPG0333
Liquid	Body Liquid Values: $\epsilon_{ps}' : 52.9$ $\sigma : 0.89$
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	20 +/- 1 °C
Lab Temperature	20 +/- 1 °C
Lab Humidity	30-70 %

Frequency MHz	1 g SAR (W/kg/W)	10 g SAR (W/kg/W)
	measured	measured
750	8.62 (0.86)	5.73 (0.57)





SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.15.5.21.MVGB.B

8 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	Manufacturer / Model	Identification No.	Current Calibration Date	Next Calibration Date
SAM Phantom	MVG	SN-13/09-SAM68	Validated. No cal required.	Validated. No cal required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rohde & Schwarz ZVM	100203	05/2019	05/2022
Network Analyzer – Calibration kit	Rohde & Schwarz ZV-Z235	101223	05/2019	05/2022
Calipers	Mitutoyo	SN 0009732	10/2019	10/2022
Reference Probe	MVG	EPGO333 SN 41/18	05/2020	05/2021
Multimeter	Keithley 2000	1160271	02/2020	02/2023
Signal Generator	Rohde & Schwarz SMB	106589	04/2019	04/2022
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	NI-USB 5680	170100013	05/2019	05/2022
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Temperature / Humidity Sensor	Testo 184 H1	44220687	05/2020	05/2023

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Dipole Impedance and Return Loss calibration Report

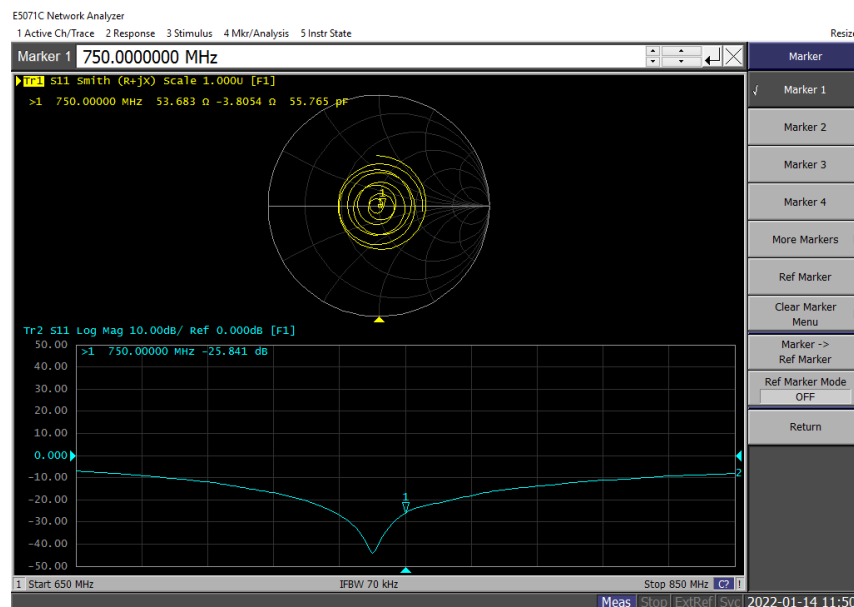
Object: SID750- SN 50/20 DIP 0G750-506
Calibration Date: January 14, 2022
Calibration reference: IEEE Std 1528:2013, IEC 62209-1:2016, FCC KDB 865664 D01
Calibrated By: *Janet Wei* (Janet Wei, SAR project engineer)
Reviewed By: *Winner Zhang* (Winner Zhang, Technical manager)

Environment of Test Site

Temperature:	18 ~ 25 C
Humidity:	50~60% RH
Atmospheric Pressure:	1011 mbar

Test Data

Measurement Plot for Head TSL In 2022



Comparison with Original report

Items	Calibrated By MVG	Calibrated By JYT In 2022	Deviation	Limit
Impedence for Head TSL	54.0Ω -3.70jΩ	53.68Ω -3.81jΩ	-0.32Ω -0.11jΩ	±5Ω
Return Loss for Head TSL	-25.31	-25.84	2.09%	±20%(No less than 20 dB)

Result

Compliance

JianYan Testing Group Shenzhen Co., Ltd.

No.101, Building 8, Innovation Wisdom Port, No.155 Hongtian Road, Huangpu Community, Xinqiao Street, Bao'an District, Shenzhen, Guangdong, People's Republic of China.

Telephone: +86 (0) 755 23118282 Fax: +86 (0) 755 23116366, E-mail: info-JYTee@lets.com

Project No.: JYTSZR2212047



SAR Reference Dipole Calibration Report

Ref : ACR.15.6.21.MVGB.B

Cancel and replace the report ACR.15.6.21.MVGB.A

JIANYAN TESTING GROUP SHENZHEN CO.,LTD.

No.110~116, BUILDING B, JINYUAN BUSINESS BUILDING,
XIXIANG ROAD, BAOAN DISTRICT,
SHENZHEN, GUANGDONG, PR CHINA

MVG COMOSAR REFERENCE DIPOLE

FREQUENCY: 835 MHZ

SERIAL NO.: SN 50/20 DIP 0G835-507

Calibrated at MVG

Z.I. de la pointe du diable

Technopôle Brest Iroise – 295 avenue Alexis de Rochon

29280 PLOUZANE - FRANCE

Calibration date: 01/14/2021



Accreditations #2-6789 and #2-6814
Scope available on www.cofrac.fr

Summary:

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



SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.15.6.21.MVGB.B

	<i>Name</i>	<i>Function</i>	<i>Date</i>	<i>Signature</i>
<i>Prepared by :</i>	Jérôme LUC	Technical Manager	1/15/2021	<i>JES</i>
<i>Checked by :</i>	Jérôme LUC	Technical Manager	1/15/2021	<i>JES</i>
<i>Approved by :</i>	Yann Toutain	Laboratory Director	2/8/2021	<i>Yann Toutain</i>

2021.02.0
8 17:47:44
+01'00'

	<i>Customer Name</i>
<i>Distribution :</i>	JianYan Testing Group Shenzhen Co.,Ltd.

<i>Issue</i>	<i>Name</i>	<i>Date</i>	<i>Modifications</i>
A	Jérôme LUC	1/15/2021	Initial release
B	Jérôme LUC	2/8/2021	Change customer name/address



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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.15.6.21.MVGB.B

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 50/20 DIP 0G835-507
Product Condition (new / used)	New

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

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



Figure 1 – MVG COMOSAR Validation Dipole

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4 MEASUREMENT METHOD

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

4.1 RETURN LOSS REQUIREMENTS

The dipole used for SAR system validation measurements and checks must have a return loss of -20 dB or better. The return loss measurement shall be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. A direct method is used with a network analyser and its calibration kit, both with a valid ISO17025 calibration.

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 dimension's 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. A direct method is used with a ISO17025 calibrated caliper.

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	0.08 LIN

5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

Length (mm)	Expanded Uncertainty on Length
0 - 300	0.20 mm
300 - 450	0.44 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.



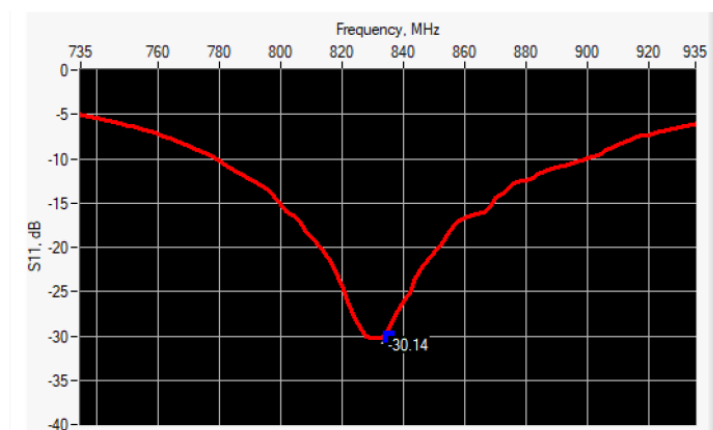
SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.15.6.21.MVGB.B

Scan Volume	Expanded Uncertainty
1 g	19 % (SAR)
10 g	19 % (SAR)

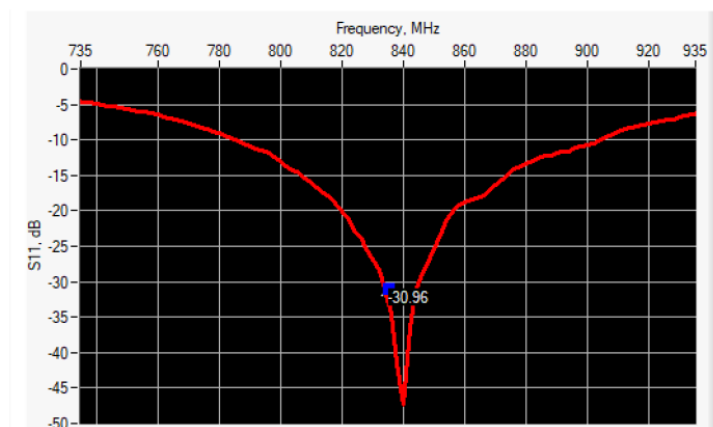
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
835	-30.14	-20	51.3 Ω - 2.8 j Ω

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
835	-30.96	-20	47.2 Ω - 0.4 j Ω



SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.15.6.21.MVGB.B

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 %.	
450	290.0 ±1 %.		166.7 ±1 %.		6.35 ±1 %.	
750	176.0 ±1 %.		100.0 ±1 %.		6.35 ±1 %.	
835	161.0 ±1 %.	161.29	89.8 ±1 %.	89.25	3.6 ±1 %.	3.59
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 %.	
3300	-		-		-	
3500	37.0 ±1 %.		26.4 ±1 %.		3.6 ±1 %.	
3700	34.7 ±1 %.		26.4 ±1 %.		3.6 ±1 %.	
3900	-		-		-	
4200	-		-		-	
4600	-		-		-	
4900	-		-		-	

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.

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.15.6.21.MVGB.B

7.1 HEAD LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ϵ_r)		Conductivity (σ) S/m	
	required	measured	required	measured
300	45.3 $\pm$ 10 %		0.87 $\pm$ 10 %	
450	43.5 $\pm$ 10 %		0.87 $\pm$ 10 %	
750	41.9 $\pm$ 10 %		0.89 $\pm$ 10 %	
835	41.5 $\pm$ 10 %	40.6	0.90 $\pm$ 10 %	0.89
900	41.5 $\pm$ 10 %		0.97 $\pm$ 10 %	
1450	40.5 $\pm$ 10 %		1.20 $\pm$ 10 %	
1500	40.4 $\pm$ 10 %		1.23 $\pm$ 10 %	
1640	40.2 $\pm$ 10 %		1.31 $\pm$ 10 %	
1750	40.1 $\pm$ 10 %		1.37 $\pm$ 10 %	
1800	40.0 $\pm$ 10 %		1.40 $\pm$ 10 %	
1900	40.0 $\pm$ 10 %		1.40 $\pm$ 10 %	
1950	40.0 $\pm$ 10 %		1.40 $\pm$ 10 %	
2000	40.0 $\pm$ 10 %		1.40 $\pm$ 10 %	
2100	39.8 $\pm$ 10 %		1.49 $\pm$ 10 %	
2300	39.5 $\pm$ 10 %		1.67 $\pm$ 10 %	
2450	39.2 $\pm$ 10 %		1.80 $\pm$ 10 %	
2600	39.0 $\pm$ 10 %		1.96 $\pm$ 10 %	
3000	38.5 $\pm$ 10 %		2.40 $\pm$ 10 %	
3300	38.2 $\pm$ 10 %		2.71 $\pm$ 10 %	
3500	37.9 $\pm$ 10 %		2.91 $\pm$ 10 %	
3700	37.7 $\pm$ 10 %		3.12 $\pm$ 10 %	
3900	37.5 $\pm$ 10 %		3.32 $\pm$ 10 %	
4200	37.1 $\pm$ 10 %		3.63 $\pm$ 10 %	
4600	36.7 $\pm$ 10 %		4.04 $\pm$ 10 %	
4900	36.3 $\pm$ 10 %		4.35 $\pm$ 10 %	

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.

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.15.6.21.MVGB.B

Software	OPENSAR V5
Phantom	SN 13/09 SAM68
Probe	SN 41/18 EPG0333
Liquid	Head Liquid Values: ϵ_{ps} : 40.6 σ : 0.89
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	20 +/- 1 °C
Lab Temperature	20 +/- 1 °C
Lab Humidity	30-70 %

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	9.57 (0.96)	6.22	6.04 (0.60)
900	10.9		6.99	
1450	29		16	
1500	30.5		16.8	
1640	34.2		18.4	
1750	36.4		19.3	
1800	38.4		20.1	
1900	39.7		20.5	
1950	40.5		20.9	
2000	41.1		21.1	
2100	43.6		21.9	
2300	48.7		23.3	
2450	52.4		24	
2600	55.3		24.6	
3000	63.8		25.7	
3300	-		-	
3500	67.1		25	
3700	67.4		24.2	
3900	-		-	
4200	-		-	
4600	-		-	
4900	-		-	

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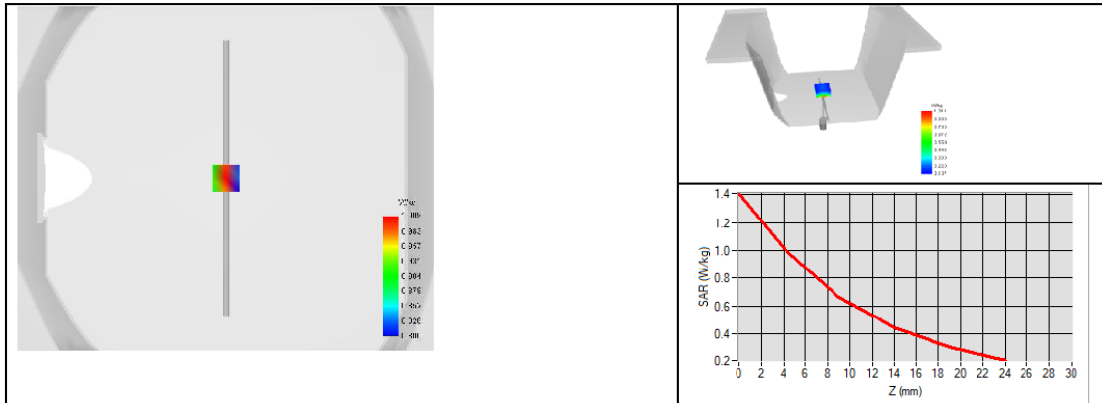
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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.15.6.21.MVGB.B

7.3 BODY LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ϵ_r')		Conductivity (σ) S/m	
	required	measured	required	measured
150	61.9 $\pm$ 10 %		0.80 $\pm$ 10 %	
300	58.2 $\pm$ 10 %		0.92 $\pm$ 10 %	
450	56.7 $\pm$ 10 %		0.94 $\pm$ 10 %	
750	55.5 $\pm$ 10 %		0.96 $\pm$ 10 %	
835	55.2 $\pm$ 10 %	52.3	0.97 $\pm$ 10 %	0.94
900	55.0 $\pm$ 10 %		1.05 $\pm$ 10 %	
915	55.0 $\pm$ 10 %		1.06 $\pm$ 10 %	
1450	54.0 $\pm$ 10 %		1.30 $\pm$ 10 %	
1610	53.8 $\pm$ 10 %		1.40 $\pm$ 10 %	
1800	53.3 $\pm$ 10 %		1.52 $\pm$ 10 %	
1900	53.3 $\pm$ 10 %		1.52 $\pm$ 10 %	
2000	53.3 $\pm$ 10 %		1.52 $\pm$ 10 %	
2100	53.2 $\pm$ 10 %		1.62 $\pm$ 10 %	
2300	52.9 $\pm$ 10 %		1.81 $\pm$ 10 %	
2450	52.7 $\pm$ 10 %		1.95 $\pm$ 10 %	
2600	52.5 $\pm$ 10 %		2.16 $\pm$ 10 %	
3000	52.0 $\pm$ 10 %		2.73 $\pm$ 10 %	
3300	51.6 $\pm$ 10 %		3.08 $\pm$ 10 %	
3500	51.3 $\pm$ 10 %		3.31 $\pm$ 10 %	
3700	51.0 $\pm$ 10 %		3.55 $\pm$ 10 %	
3900	50.8 $\pm$ 10 %		3.78 $\pm$ 10 %	
4200	50.4 $\pm$ 10 %		4.13 $\pm$ 10 %	
4600	49.8 $\pm$ 10 %		4.60 $\pm$ 10 %	
4900	49.4 $\pm$ 10 %		4.95 $\pm$ 10 %	
5200	49.0 $\pm$ 10 %		5.30 $\pm$ 10 %	
5300	48.9 $\pm$ 10 %		5.42 $\pm$ 10 %	
5400	48.7 $\pm$ 10 %		5.53 $\pm$ 10 %	
5500	48.6 $\pm$ 10 %		5.65 $\pm$ 10 %	
5600	48.5 $\pm$ 10 %		5.77 $\pm$ 10 %	
5800	48.2 $\pm$ 10 %		6.00 $\pm$ 10 %	

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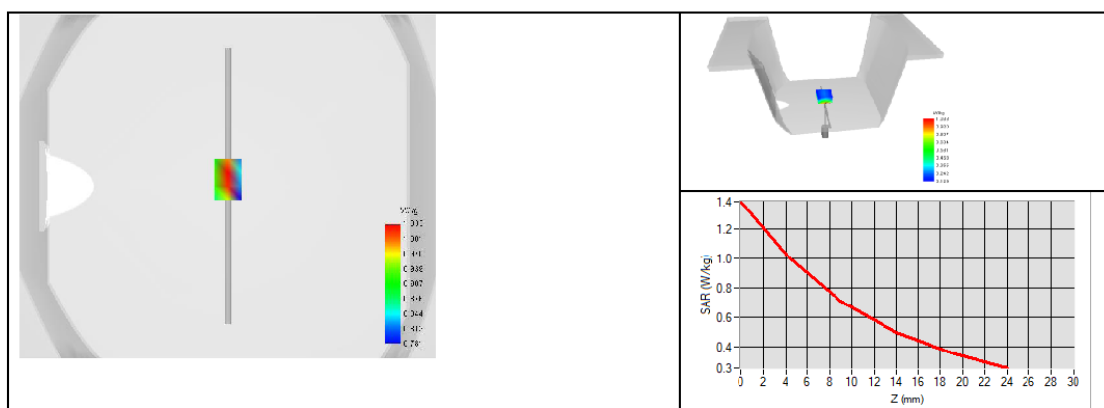
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Ref: ACR.15.6.21.MVGB.B

7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

Software	OPENSAR V5
Phantom	SN 13/09 SAM68
Probe	SN 41/18 EPG0333
Liquid	Body Liquid Values: $\epsilon_{ps}' : 52.3$ $\sigma : 0.94$
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	20 +/- 1 °C
Lab Temperature	20 +/- 1 °C
Lab Humidity	30-70 %

Frequency MHz	1 g SAR (W/kg/W)	10 g SAR (W/kg/W)
	measured	measured
835	9.77 (0.98)	6.36 (0.64)





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8 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	Manufacturer / Model	Identification No.	Current Calibration Date	Next Calibration Date
SAM Phantom	MVG	SN-13/09-SAM68	Validated. No cal required.	Validated. No cal required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rohde & Schwarz ZVM	100203	05/2019	05/2022
Network Analyzer – Calibration kit	Rohde & Schwarz ZV-Z235	101223	05/2019	05/2022
Calipers	Mitutoyo	SN 0009732	10/2019	10/2022
Reference Probe	MVG	EPGO333 SN 41/18	05/2020	05/2021
Multimeter	Keithley 2000	1160271	02/2020	02/2023
Signal Generator	Rohde & Schwarz SMB	106589	04/2019	04/2022
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	NI-USB 5680	170100013	05/2019	05/2022
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Temperature / Humidity Sensor	Testo 184 H1	44220687	05/2020	05/2023

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Dipole Impedance and Return Loss calibration Report

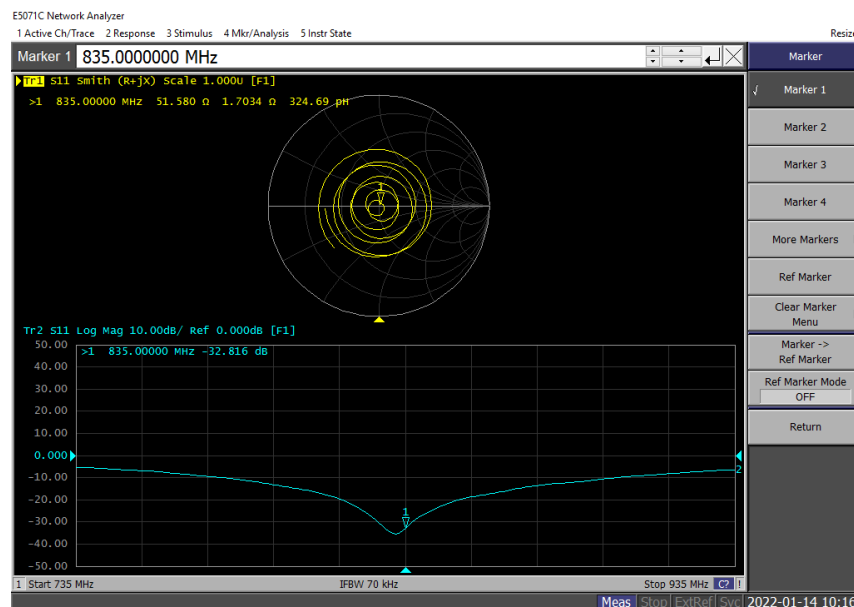
Object: SID835 - SN 50/20 DIP 0G835-507
Calibration Date: January 14, 2022
Calibration reference: IEEE Std 1528:2013, IEC 62209-1:2016, FCC KDB 865664 D01
Calibrated By: *Janet Wei* (Janet Wei, SAR project engineer)
Reviewed By: *Winner Zhang* (Winner Zhang, Technical manager)

Environment of Test Site

Temperature:	18 ~ 25 C
Humidity:	50~60% RH
Atmospheric Pressure:	1011 mbar

Test Data

Measurement Plot for Head TSL In 2022



Comparison with Original report

Items	Calibrated By MVG	Calibrated By JYT In 2022	Deviation	Limit
Impedence for Head TSL	51.3Ω -2.8jΩ	51.58Ω +1.70jΩ	0.28Ω -4.50jΩ	±5Ω
Return Loss for Head TSL	-30.14	-32.82	8.89%	±20%(No less than 20 dB)

Result

Compliance

JianYan Testing Group Shenzhen Co., Ltd.

No.101, Building 8, Innovation Wisdom Port, No.155 Hongtian Road, Huangpu Community, Xinqiao Street, Bao'an District, Shenzhen, Guangdong, People's Republic of China.

Telephone: +86 (0) 755 23118282 Fax: +86 (0) 755 23116366, E-mail: info-JYTee@lets.com

Project No.: JYTSZR2212047



SAR Reference Dipole Calibration Report

Ref : ACR.15.9.21.MVGB.B

Cancel and replace the report ACR.15.9.21.MVGB.A

JIANYAN TESTING GROUP SHENZHEN CO.,LTD.

No.110~116, BUILDING B, JINYUAN BUSINESS BUILDING,
XIXIANG ROAD, BAOAN DISTRICT,
SHENZHEN, GUANGDONG, PR CHINA

MVG COMOSAR REFERENCE DIPOLE

FREQUENCY: 1750 MHZ

SERIAL NO.: SN 50/20 DIP 1G750-510

Calibrated at MVG

Z.I. de la pointe du diable

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

Calibration date: 01/14/2021



Accreditations #2-6789 and #2-6814
Scope available on www.cofrac.fr

Summary:

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



SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.15.9.21.MVGB.B

	<i>Name</i>	<i>Function</i>	<i>Date</i>	<i>Signature</i>
<i>Prepared by :</i>	Jérôme LUC	Technical Manager	1/15/2021	<i>JES</i>
<i>Checked by :</i>	Jérôme LUC	Technical Manager	1/15/2021	<i>JES</i>
<i>Approved by :</i>	Yann Toutain	Laboratory Director	2/8/2021	<i>Yann Toutain</i>

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+01'00'

	<i>Customer Name</i>
<i>Distribution :</i>	JianYan Testing Group Shenzhen Co.,Ltd.

<i>Issue</i>	<i>Name</i>	<i>Date</i>	<i>Modifications</i>
A	Jérôme LUC	1/15/2021	Initial release
B	Jérôme LUC	2/8/2021	Change customer name/address



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SAR REFERENCE DIPOLE CALIBRATION REPORT

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1 INTRODUCTION

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

2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR 1750 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID1750
Serial Number	SN 50/20 DIP 1G750-510
Product Condition (new / used)	New

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

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



Figure 1 – MVG COMOSAR Validation Dipole

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4 MEASUREMENT METHOD

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

4.1 RETURN LOSS REQUIREMENTS

The dipole used for SAR system validation measurements and checks must have a return loss of -20 dB or better. The return loss measurement shall be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. A direct method is used with a network analyser and its calibration kit, both with a valid ISO17025 calibration.

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 dimension's 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. A direct method is used with a ISO17025 calibrated caliper.

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	0.08 LIN

5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

Length (mm)	Expanded Uncertainty on Length
0 - 300	0.20 mm
300 - 450	0.44 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.



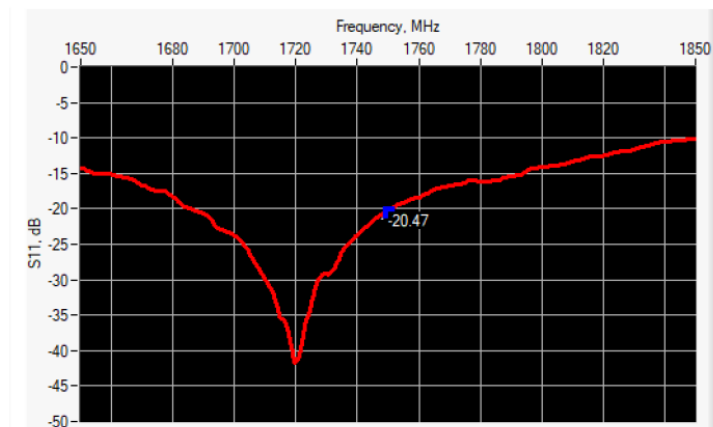
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Ref: ACR.15.9.21.MVGB.B

Scan Volume	Expanded Uncertainty
1 g	19 % (SAR)
10 g	19 % (SAR)

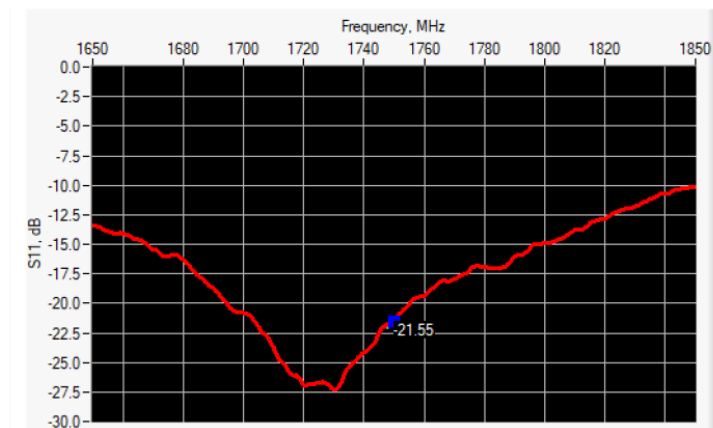
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
1750	-20.47	-20	$40.7 \Omega + 1.3 j\Omega$

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
1750	-21.55	-20	$42.4 \Omega - 3.4 j\Omega$

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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 %.	
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 %.	75.36	42.9 ±1 %.	42.48	3.6 ±1 %.	3.60
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 %.	
3300	-		-		-	
3500	37.0 ±1 %.		26.4 ±1 %.		3.6 ±1 %.	
3700	34.7 ±1 %.		26.4 ±1 %.		3.6 ±1 %.	
3900	-		-		-	
4200	-		-		-	
4600	-		-		-	
4900	-		-		-	

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.

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7.1 HEAD LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ϵ_r)		Conductivity (σ) S/m	
	required	measured	required	measured
300	45.3 $\pm$ 10 %		0.87 $\pm$ 10 %	
450	43.5 $\pm$ 10 %		0.87 $\pm$ 10 %	
750	41.9 $\pm$ 10 %		0.89 $\pm$ 10 %	
835	41.5 $\pm$ 10 %		0.90 $\pm$ 10 %	
900	41.5 $\pm$ 10 %		0.97 $\pm$ 10 %	
1450	40.5 $\pm$ 10 %		1.20 $\pm$ 10 %	
1500	40.4 $\pm$ 10 %		1.23 $\pm$ 10 %	
1640	40.2 $\pm$ 10 %		1.31 $\pm$ 10 %	
1750	40.1 $\pm$ 10 %	43.8	1.37 $\pm$ 10 %	1.30
1800	40.0 $\pm$ 10 %		1.40 $\pm$ 10 %	
1900	40.0 $\pm$ 10 %		1.40 $\pm$ 10 %	
1950	40.0 $\pm$ 10 %		1.40 $\pm$ 10 %	
2000	40.0 $\pm$ 10 %		1.40 $\pm$ 10 %	
2100	39.8 $\pm$ 10 %		1.49 $\pm$ 10 %	
2300	39.5 $\pm$ 10 %		1.67 $\pm$ 10 %	
2450	39.2 $\pm$ 10 %		1.80 $\pm$ 10 %	
2600	39.0 $\pm$ 10 %		1.96 $\pm$ 10 %	
3000	38.5 $\pm$ 10 %		2.40 $\pm$ 10 %	
3300	38.2 $\pm$ 10 %		2.71 $\pm$ 10 %	
3500	37.9 $\pm$ 10 %		2.91 $\pm$ 10 %	
3700	37.7 $\pm$ 10 %		3.12 $\pm$ 10 %	
3900	37.5 $\pm$ 10 %		3.32 $\pm$ 10 %	
4200	37.1 $\pm$ 10 %		3.63 $\pm$ 10 %	
4600	36.7 $\pm$ 10 %		4.04 $\pm$ 10 %	
4900	36.3 $\pm$ 10 %		4.35 $\pm$ 10 %	

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.

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