

MEAS. 35 Body Plane with Back Side 15mm on High Channel in IEEE 802.b

mode with antenna 0

Test Date: 7/9/2016

Measurement duration: 15 minutes 13 seconds

Signal: WLAN, f=2462.0 MHz, Duty Cycle: 1:1.0 Liquid Parameters: Permittivity: 51.90; Conductivity: 2.03 S/m

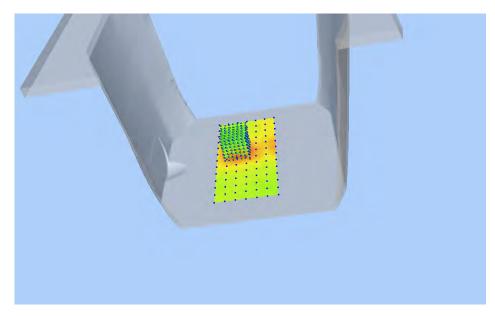
Test condition: Ambient Temperature: 22.9°C, Liquid Temperature: 21.6°C

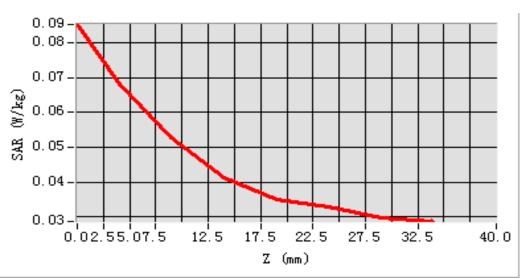
Probe:SN 34/15 SSE2 EPGO265, ConvF: 2.55Area Scan:sam_direct_droit2_surf12mm.txt, h= 5.00 mmZoom Scan:7x7x7,dx=5mm, dy=5mm, dz=5mm,Complete

Maximum location: X=-16.000000, Y=12.000000

SAR 10g (W/Kg): 0.048175 SAR 1g (W/Kg): 0.066119 Power drift (%): -3.77

3D screen shot







MEAS. 36 Body Plane with Top Edge 10mm on High Channel in IEEE 802.b

mode with antenna 0

Test Date: 7/9/2016

Measurement duration: 16 minutes 55 seconds

Signal: WLAN, f=2462.0 MHz, Duty Cycle: 1:1.0 Liquid Parameters: Permittivity: 51.90; Conductivity: 2.03 S/m

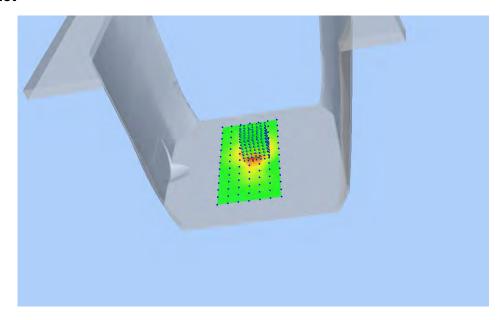
Test condition: Ambient Temperature: 22.9°C, Liquid Temperature: 21.6°C

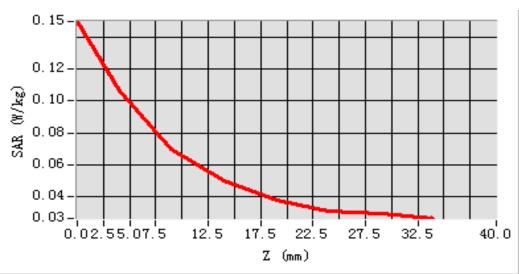
Probe:SN 34/15 SSE2 EPGO265, ConvF: 2.55Area Scan:sam_direct_droit2_surf12mm.txt, h= 5.00 mmZoom Scan:7x7x7,dx=5mm, dy=5mm, dz=5mm,Complete

Maximum location: X=8.000000, Y=12.000000

SAR 10g (W/Kg): 0.067282 SAR 1g (W/Kg): 0.103439 Power drift (%): 0.13

3D screen shot







MEAS. 37 Right Head with Cheek on Low Channel in IEEE 802.b mode with

antenna 1

Test Date: 8/9/2016

Measurement duration: 12 minutes 19 seconds

Signal: WLAN, f=2412.0 MHz, Duty Cycle: 1:1.0 Liquid Parameters: Permittivity: 40.06; Conductivity: 1.80 S/m

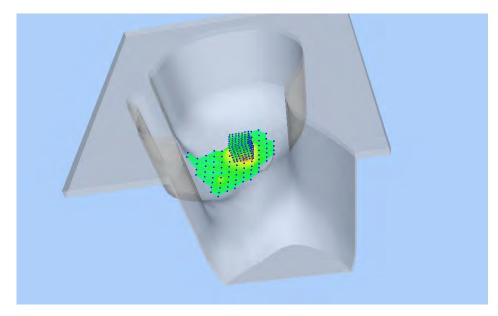
Test condition: Ambient Temperature: 22.6°C, Liquid Temperature: 21.5°C

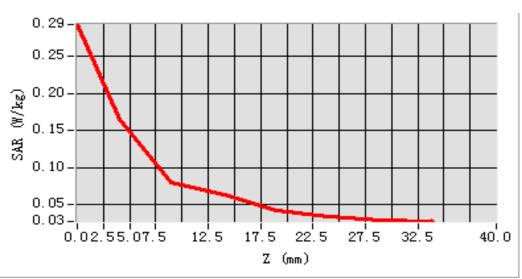
Probe:SN 34/15 SSE2 EPGO265, ConvF: 2.47Area Scan:sam_direct_droit2_surf12mm.txt, h= 5.00 mmZoom Scan:7x7x7,dx=5mm, dy=5mm, dz=5mm,Complete

Maximum location: X=-12.000000, Y=12.000000

SAR 10g (W/Kg): 0.084829 SAR 1g (W/Kg): 0.150886 Power drift (%): -2.68

3D screen shot







MEAS. 38 Body Plane with Back Side 15mm on Low Channel in IEEE 802.b

mode with antenna 1

Test Date: 7/9/2016

Measurement duration: 11 minutes 46 seconds

Signal: WLAN, f=2412.0 MHz, Duty Cycle: 1:1.0 Liquid Parameters: Permittivity: 52.12; Conductivity: 1.95 S/m

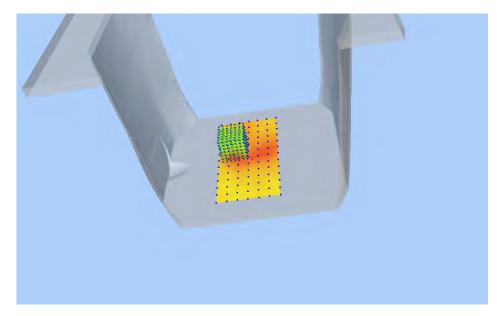
Test condition: Ambient Temperature: 22.9°C, Liquid Temperature: 21.6°C

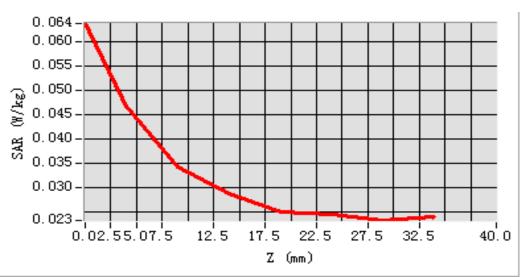
Probe:SN 34/15 SSE2 EPGO265, ConvF: 2.55Area Scan:sam_direct_droit2_surf12mm.txt, h= 5.00 mmZoom Scan:7x7x7,dx=5mm, dy=5mm, dz=5mm,Complete

Maximum location: X=-16.000000, Y=12.000000

SAR 10g (W/Kg): 0.033521 SAR 1g (W/Kg): 0.045475 Power drift (%): 0.97

3D screen shot







MEAS. 39 Body Plane with Back Side 10mm on Low Channel in IEEE 802.b

mode with antenna 1

Test Date: 7/9/2016

Measurement duration: 12 minutes 5 seconds

Signal: WLAN, f=2412.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters: Permittivity: 52.12; Conductivity: 1.95 S/m

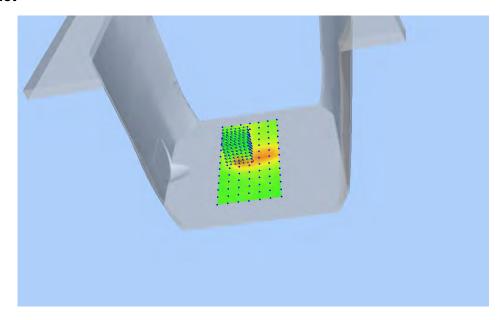
Test condition: Ambient Temperature: 22.9°C, Liquid Temperature: 21.6°C

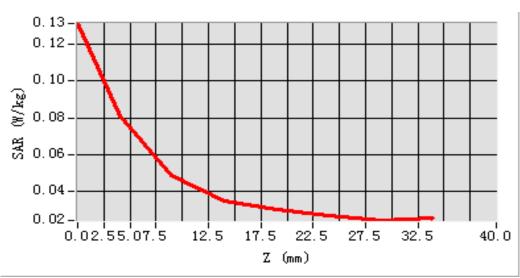
Probe:SN 34/15 SSE2 EPGO265, ConvF: 2.55Area Scan:sam_direct_droit2_surf12mm.txt, h= 5.00 mmZoom Scan:7x7x7,dx=5mm, dy=5mm, dz=5mm,Complete

Maximum location: X=-16.000000, Y=12.000000

SAR 10g (W/Kg): 0.046422 SAR 1g (W/Kg): 0.077511 Power drift (%): -1.46

3D screen shot







MEAS. 40 Left Head with Cheek on Channel 54 in IEEE 802.n(HT-40) mode with

antenna 0

Test Date: 10/9/2016

Measurement duration: 20 minutes 44 seconds

Signal: WLAN, f=5270.0 MHz, Duty Cycle: 1:1.0 Liquid Parameters: Permittivity: 35.73; Conductivity: 4.87 S/m

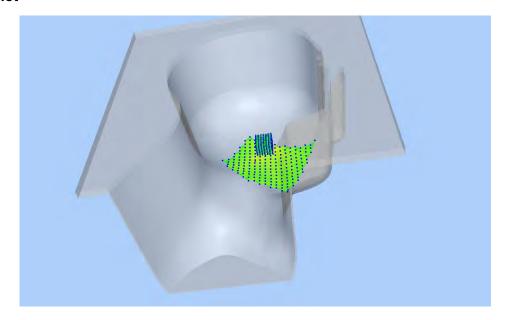
Test condition: Ambient Temperature: 22.7°C, Liquid Temperature: 21.1°C

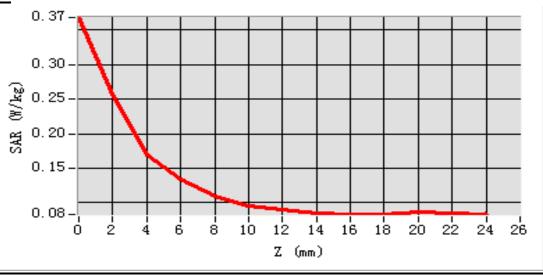
Probe:SN 34/15 SSE2 EPGO265, ConvF: 1.81Area Scan:sam_direct_droit2_surf8mm.txt, h= 5.00 mmZoom Scan:7x7x12,dx=4mm, dy=4mm, dz=2mm,Complete

Maximum location: X=-16.000000, Y=24.000000

SAR 10g (W/Kg): 0.128714
SAR 1g (W/Kg): 0.239832
Power drift (%): 0.99

3D screen shot







MEAS. 41 Left Head with Cheek on Channel 102 in IEEE 802.n(HT-40) mode

with antenna 0

Test Date: 10/9/2016

Measurement duration: 20 minutes 43 seconds

Signal: WLAN, f=5510.0 MHz, Duty Cycle: 1:1.0 Liquid Parameters: Permittivity: 35.25; Conductivity: 5.17 S/m

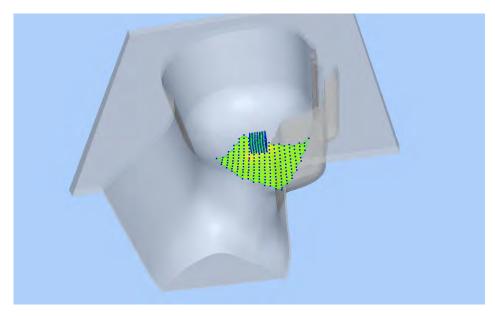
Test condition: Ambient Temperature: 22.7°C, Liquid Temperature: 21.1°C

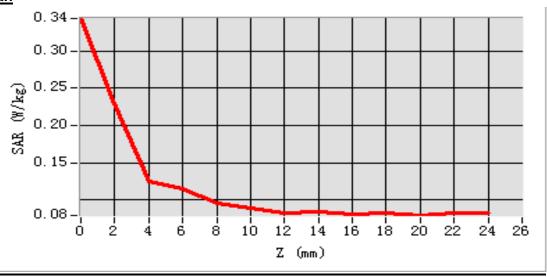
Probe:SN 34/15 SSE2 EPGO265, ConvF: 2.08Area Scan:sam_direct_droit2_surf8mm.txt, h= 5.00 mmZoom Scan:7x7x12,dx=4mm, dy=4mm, dz=2mm,Complete

Maximum location: X=-16.000000, Y=24.000000

SAR 10g (W/Kg): 0.119970 SAR 1g (W/Kg): 0.221704 Power drift (%): -2.94

3D screen shot







MEAS. 42 Left Head with Cheek on Channel 159 in IEEE 802.ac(HT-40) mode

with antenna 0

Test Date: 10/9/2016

Measurement duration: 17 minutes 50 seconds

Signal:WLAN, f=5790.0 MHz, Duty Cycle: 1:1.0Liquid Parameters:Permittivity: 34.34; Conductivity: 5.45 S/m

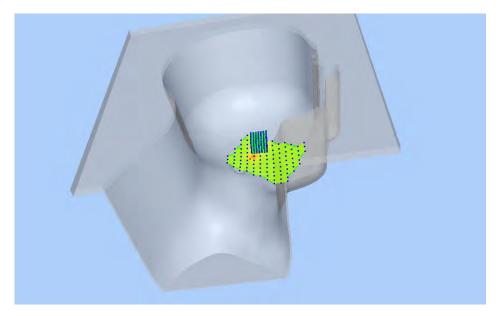
Test condition: Ambient Temperature: 22.7°C, Liquid Temperature: 21.1°C

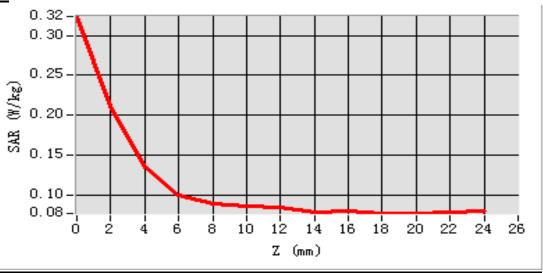
Probe:SN 34/15 SSE2 EPGO265, ConvF: 1.88Area Scan:sam_direct_droit2_surf10mm.txt, h= 5.00 mmZoom Scan:7x7x12,dx=4mm, dy=4mm, dz=2mm,Complete

Maximum location: X=-16.000000, Y=24.000000

SAR 10g (W/Kg): 0.109761 SAR 1g (W/Kg): 0.202149 Power drift (%): -3.10

3D screen shot







MEAS. 43 Body Plane with Back Side 15mm on Channel 54 in IEEE 802.n(HT-

40) mode with antenna 0

Test Date: 9/9/2016

Measurement duration: 26 minutes 55 seconds

Signal: WLAN, f=5270.0 MHz, Duty Cycle: 1:1.0 Liquid Parameters: Permittivity: 49.12; Conductivity: 5.55 S/m

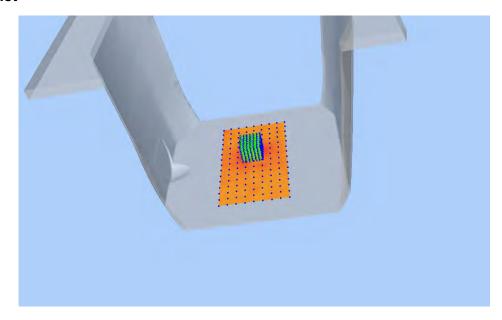
Test condition: Ambient Temperature: 22.5°C, Liquid Temperature: 21.1°C

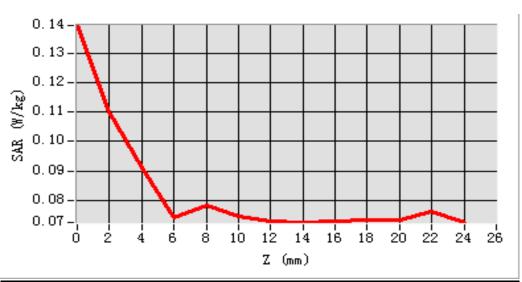
Probe:SN 34/15 SSE2 EPGO265, ConvF: 1.85Area Scan:sam_direct_droit2_surf10mm.txt, h= 5.00 mmZoom Scan:7x7x12,dx=4mm, dy=4mm, dz=2mm,Complete

Maximum location: X=0.000000, Y=8.000000

SAR 10g (W/Kg): 0.089271 SAR 1g (W/Kg): 0.101026 Power drift (%): -2.71

3D screen shot







MEAS. 44 Body Plane with Back Side 15mm on Channel 102 in IEEE 802.n(HT-

40) mode with antenna 0

Test Date: 9/9/2016

Measurement duration: 27 minutes 25 seconds

Signal: WLAN, f=5510.0 MHz, Duty Cycle: 1:1.0 Liquid Parameters: Permittivity: 48.86; Conductivity: 5.63 S/m

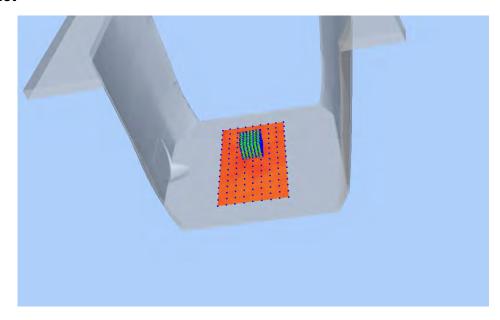
Test condition: Ambient Temperature: 22.5°C, Liquid Temperature: 21.1°C

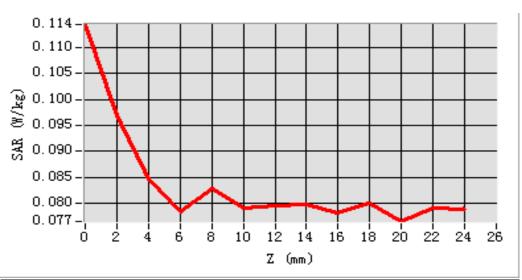
Probe:SN 34/15 SSE2 EPGO265, ConvF: 2.15Area Scan:sam_direct_droit2_surf10mm.txt, h= 5.00 mmZoom Scan:7x7x12,dx=4mm, dy=4mm, dz=2mm,Complete

Maximum location: X=0.000000, Y=18.000000

SAR 10g (W/Kg): 0.091168 SAR 1g (W/Kg): 0.094842 Power drift (%): -1.47

3D screen shot







MEAS. 45 Body Plane with Back Side 15mm on Channel 159 in IEEE 802.ac(HT-

40) mode with antenna 0

Test Date: 9/9/2016

Measurement duration: 29 minutes 26 seconds

Signal: WLAN, f=5790.0 MHz, Duty Cycle: 1:1.0 Liquid Parameters: Permittivity: 46.96; Conductivity: 6.07 S/m

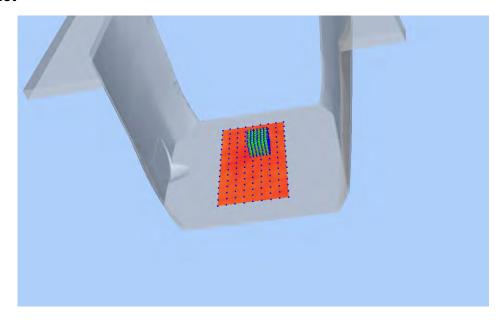
Test condition: Ambient Temperature: 22.5°C, Liquid Temperature: 21.1°C

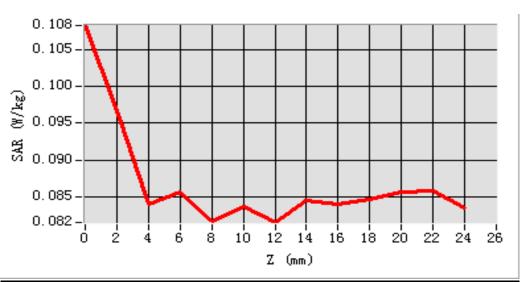
Probe:SN 34/15 SSE2 EPGO265, ConvF: 1.93Area Scan:sam_direct_droit2_surf10mm.txt, h= 5.00 mmZoom Scan:7x7x12,dx=4mm, dy=4mm, dz=2mm,Complete

Maximum location: X=10.000000, Y=18.000000

SAR 10g (W/Kg): 0.093681 SAR 1g (W/Kg): 0.096270 Power drift (%): 4.24

3D screen shot







MEAS. 46 Right Head with Tilt on Channel 46 in IEEE 802.ac(HT-40) mode with

antenna 1

Test Date: 10/9/2016

Measurement duration: 20 minutes 38 seconds

Signal: WLAN, f=5230.0 MHz, Duty Cycle: 1:1.0 Liquid Parameters: Permittivity: 36.11; Conductivity: 4.83 S/m

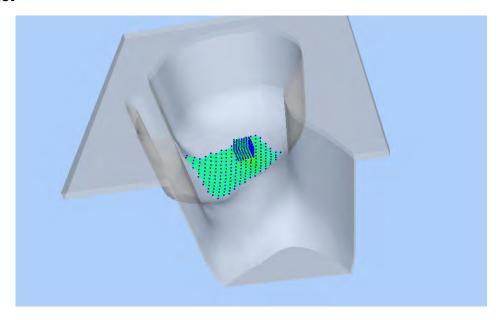
Test condition: Ambient Temperature: 22.7°C, Liquid Temperature: 21.1°C

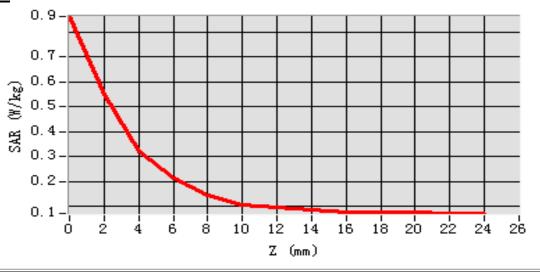
Probe:SN 34/15 SSE2 EPGO265, ConvF: 1.81Area Scan:sam_direct_droit2_surf8mm.txt, h= 5.00 mmZoom Scan:7x7x12,dx=4mm, dy=4mm, dz=2mm,Complete

Maximum location: X=-8.000000, Y=16.000000

SAR 10g (W/Kg): 0.191474 SAR 1g (W/Kg): 0.489027 Power drift (%): -4.18

3D screen shot







MEAS. 47 Right Head with Tilt on Channel 110 in IEEE 802.ac(HT-40) mode with

antenna 1

Test Date: 10/9/2016

Measurement duration: 18 minutes 41 seconds

Signal: WLAN, f=5550.0 MHz, Duty Cycle: 1:1.0 Liquid Parameters: Permittivity: 35.11; Conductivity: 5.21 S/m

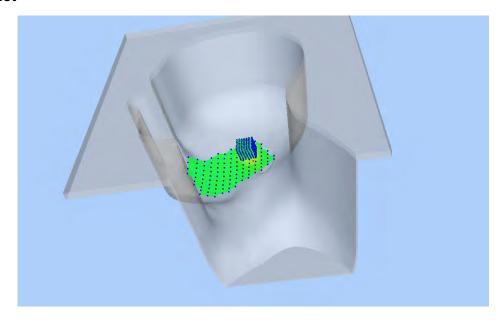
Test condition: Ambient Temperature: 22.7°C, Liquid Temperature: 21.1°C

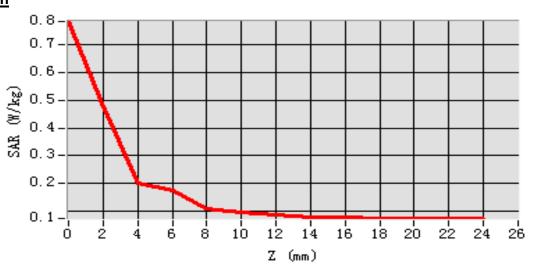
Probe:SN 34/15 SSE2 EPGO265, ConvF: 2.08Area Scan:sam_direct_droit2_surf10mm.txt, h= 5.00 mmZoom Scan:7x7x12,dx=4mm, dy=4mm, dz=2mm,Complete

Maximum location: X=-6.000000, Y=14.000000

SAR 10g (W/Kg): 0.173530 SAR 1g (W/Kg): 0.433088 Power drift (%): 2.74

3D screen shot







MEAS. 48 Right Head with Tilt on Channel 157 in IEEE 802.a mode with

antenna 1

Test Date: 10/9/2016

Measurement duration: 18 minutes 43 seconds

Signal: WLAN, f=5785.0 MHz, Duty Cycle: 1:1.0
Liquid Parameters: Permittivity: 34.63; Conductivity: 5.34 S/m

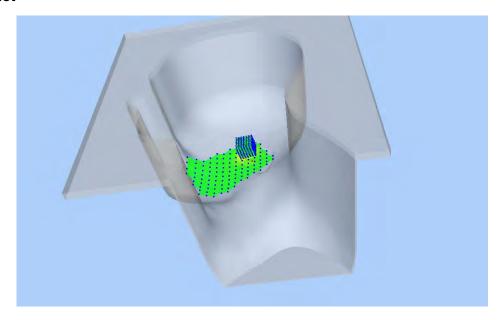
Test condition: Ambient Temperature: 22.7°C, Liquid Temperature: 21.1°C

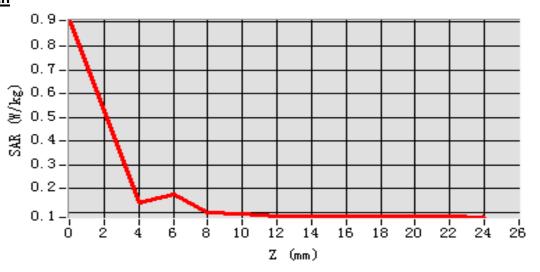
Probe:SN 34/15 SSE2 EPGO265, ConvF: 1.88Area Scan:sam_direct_droit2_surf10mm.txt, h= 5.00 mmZoom Scan:7x7x12,dx=4mm, dy=4mm, dz=2mm,Complete

Maximum location: X=-6.000000, Y=24.000000

SAR 10g (W/Kg): 0.168798 SAR 1g (W/Kg): 0.450521 Power drift (%): -3.36

3D screen shot







MEAS. 49 Body Plane with Back Side 15mm on Channel 46 in IEEE 802.ac(HT-

40) mode with antenna 1

Test Date: 9/9/2016

Measurement duration: 28 minutes 37 seconds

Signal: WLAN, f=5230.0 MHz, Duty Cycle: 1:1.0 Liquid Parameters: Permittivity: 49.33; Conductivity: 5.42 S/m

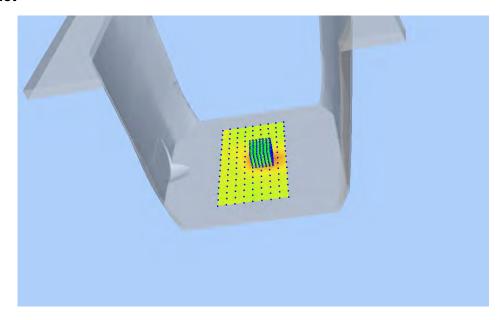
Test condition: Ambient Temperature: 22.5°C, Liquid Temperature: 21.1°C

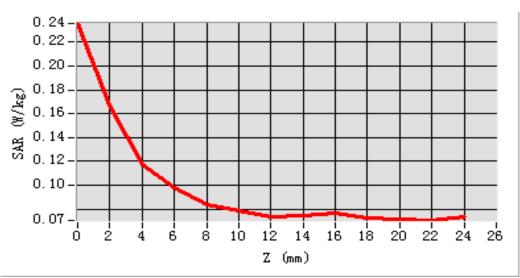
Probe:SN 34/15 SSE2 EPGO265, ConvF: 1.85Area Scan:sam_direct_droit2_surf10mm.txt, h= 5.00 mmZoom Scan:7x7x12,dx=4mm, dy=4mm, dz=2mm,Complete

Maximum location: X=10.000000, Y=-2.000000

SAR 10g (W/Kg): 0.100572 SAR 1g (W/Kg): 0.134632 Power drift (%): -2.02

3D screen shot







MEAS. 50 Body Plane with Back Side 15mm on Channel 110 in IEEE 802.ac(HT-

40) mode with antenna 1

Test Date: 9/9/2016

Measurement duration: 28 minutes 57 seconds

Signal: WLAN, f=5550.0 MHz, Duty Cycle: 1:1.0 Liquid Parameters: Permittivity: 48.05; Conductivity: 5.81 S/m

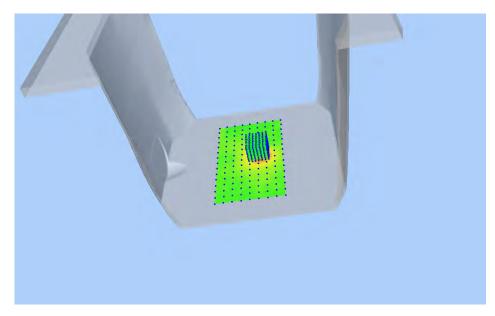
Test condition: Ambient Temperature: 22.5°C, Liquid Temperature: 21.1°C

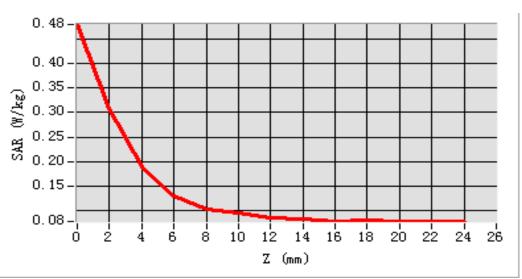
Probe:SN 34/15 SSE2 EPGO265, ConvF: 2.15Area Scan:sam_direct_droit2_surf10mm.txt, h= 5.00 mmZoom Scan:7x7x12,dx=4mm, dy=4mm, dz=2mm,Complete

Maximum location: X=10.000000, Y=8.000000

SAR 10g (W/Kg): 0.132884 SAR 1g (W/Kg): 0.221324 Power drift (%): -2.33

3D screen shot







MEAS. 51 Body Plane with Back Side 15mm on Channel 157 in IEEE 802.a

mode with antenna 1

Test Date: 9/9/2016

Measurement duration: 28 minutes 10 seconds

Signal: WLAN, f=5785.0 MHz, Duty Cycle: 1:1.0 Liquid Parameters: Permittivity: 47.22; Conductivity: 5.94 S/m

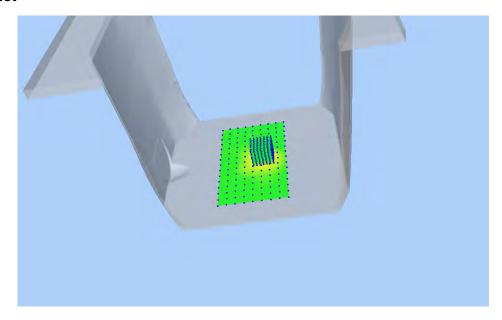
Test condition: Ambient Temperature: 22.5°C, Liquid Temperature: 21.1°C

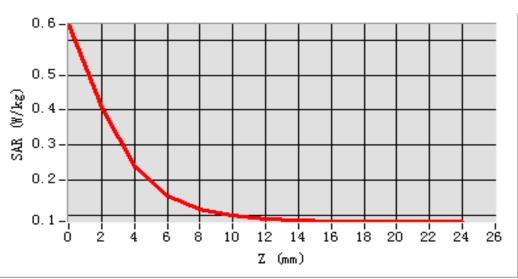
Probe:SN 34/15 SSE2 EPGO265, ConvF: 1.93Area Scan:sam_direct_droit2_surf10mm.txt, h= 5.00 mmZoom Scan:7x7x12,dx=4mm, dy=4mm, dz=2mm,Complete

Maximum location: X=10.000000, Y=-2.000000

SAR 10g (W/Kg): 0.152136 SAR 1g (W/Kg): 0.276361 Power drift (%): -1.00

3D screen shot







MEAS. 52 Left Head with Cheek on High Channel in LTE Band 2 mode with

1RB (Bandwidth 15MHz)

Test Date: 27/9/2016

Measurement duration: 12 minutes 24 seconds

Signal: LTE, f=1902.5 MHz, Duty Cycle: 1:1.0 Liquid Parameters: Permittivity: 39.58; Conductivity: 1.40 S/m

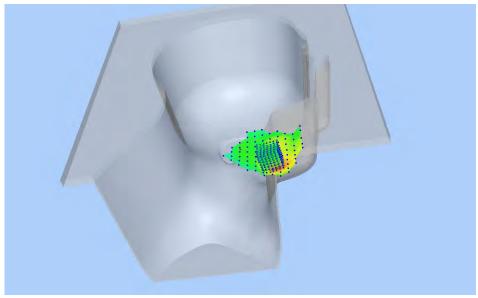
Test condition: Ambient Temperature: 22.8°C, Liquid Temperature: 21.3°C

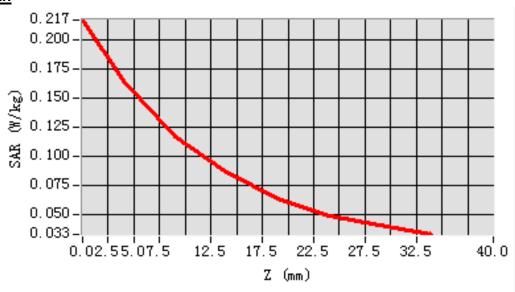
Probe:SN 34/15 SSE2 EPGO265, ConvF: 2.35Area Scan:sam_direct_droit2_surf12mm.txt, h= 5.00 mmZoom Scan:7x7x7,dx=5mm, dy=5mm, dz=5mm,Complete

Maximum location: X=-48.000000, Y=-48.000000

SAR 10g (W/Kg):0.108926SAR 1g (W/Kg):0.168425Power drift (%):3.42

3D screen shot







MEAS. 53 Body Plane with Front side 15mm on High Channel in LTE band 2

mode with 1RB(Bandwidth 15MHz)

Test Date: 27/9/2016

Measurement duration: 11 minutes 45 seconds

Signal: LTE, f=1902.5 MHz, Duty Cycle: 1:1.0 Liquid Parameters: Permittivity: 54.05; Conductivity: 1.51 S/m

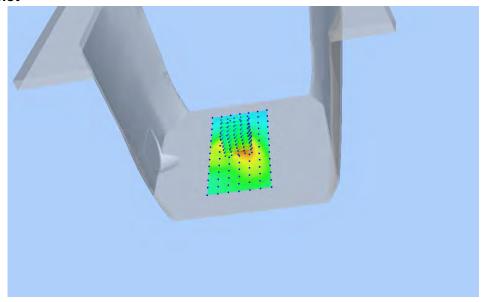
Test condition: Ambient Temperature: 22.8°C, Liquid Temperature: 21.3°C

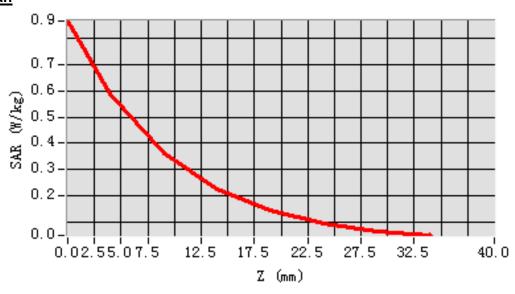
Probe:SN 34/15 SSE2 EPGO265, ConvF: 2.42Area Scan:sam_direct_droit2_surf12mm.txt, h= 5.00 mmZoom Scan:5x5x7,dx=8mm, dy=8mm, dz=5mm,Complete

Maximum location: X=-4.000000, Y=12.000000

SAR 10g (W/Kg): 0.318488 SAR 1g (W/Kg): 0.564975 Power drift (%): -2.97

3D screen shot







MEAS. 54 Body Plane with Body Bottom Edge 10mm on Low Channel in LTE

band 2 mode with 1RB(Bandwidth 15MHz)

Test Date: 27/9/2016

Measurement duration: 11 minutes 23 seconds

Signal: LTE, f=1857.5 MHz, Duty Cycle: 1:1.0 Liquid Parameters: Permittivity: 54.87; Conductivity: 1.49 S/m

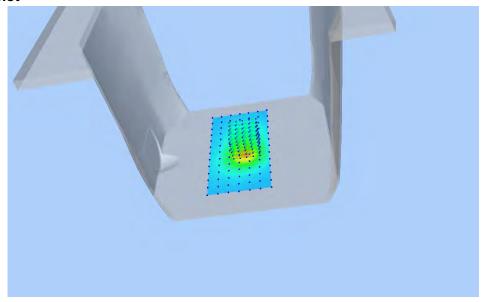
Test condition: Ambient Temperature: 22.8°C, Liquid Temperature: 21.3°C

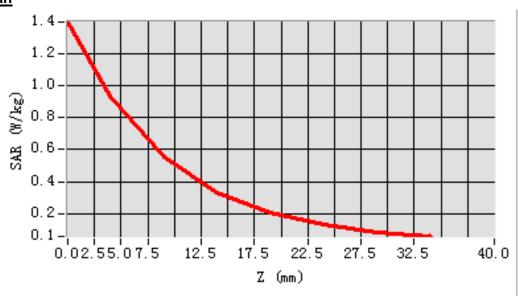
Probe:SN 34/15 SSE2 EPGO265, ConvF: 2.42Area Scan:sam_direct_droit2_surf12mm.txt, h= 5.00 mmZoom Scan:5x5x7,dx=8mm, dy=8mm, dz=5mm,Complete

Maximum location: X=8.000000, Y=0.000000

SAR 10g (W/Kg): 0.455472 SAR 1g (W/Kg): 0.845314 Power drift (%): -1.69

3D screen shot







MEAS. 55 Body Plane with Body Bottom Edge 10mm on Low Channel in LTE

band 4 mode with 1RB(Bandwidth 15MHz)

Test Date: 27/9/2016

Measurement duration: 11 minutes 39 seconds

Signal: LTE, f=1717.5 MHz, Duty Cycle: 1:1.0 Liquid Parameters: Permittivity: 53.38; Conductivity: 1.43 S/m

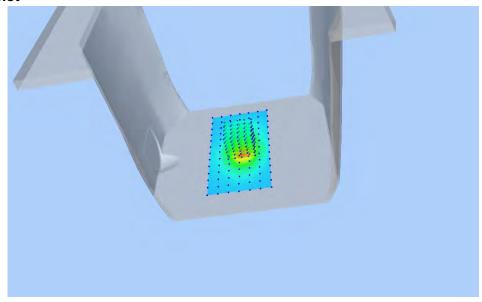
Test condition: Ambient Temperature: 22.8°C, Liquid Temperature: 21.3°C

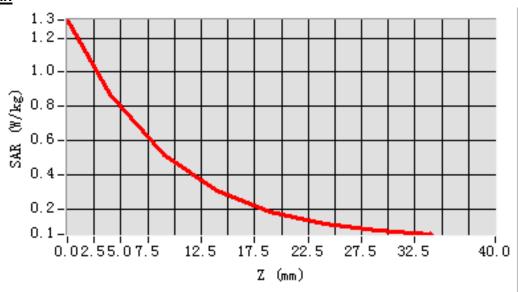
Probe:SN 34/15 SSE2 EPGO265, ConvF: 2.08Area Scan:sam_direct_droit2_surf12mm.txt, h= 5.00 mmZoom Scan:5x5x7,dx=8mm, dy=8mm, dz=5mm,Complete

Maximum location: X=-4.000000, Y=0.000000

SAR 10g (W/Kg): 0.462526 SAR 1g (W/Kg): 0.803713 Power drift (%): -0.38

3D screen shot







ANNEX D EUT EXTERNAL PHOTOS

Please refer the document "BL-SZ1680175-AW.pdf".

ANNEX E SAR TEST SETUP PHOTOS

Please refer the document "BL-SZ1680175-AS.pdf".



ANNEX F CALIBRATION REPORT

F.1 E-Field Probe



COMOSAR E-Field Probe Calibration Report

Ref: ACR.299.1.15.SATU.A

SHENZHEN BALUN TECHNOLOGY CO.,LTD.
BLOCK B, FL 1, BAISHA SCIENCE AND TECHNOLOGY
PARK, SHAHE XI ROAD,
NANSHAN DISTRICT SHENZHEN, CHANGDONG

NANSHAN DISTRICT, SHENZHEN, GUANGDONG PROVINCE, P.R. CHINA 518055

MVG COMOSAR DOSIMETRIC E-FIELD PROBE

SERIAL NO.: SN 34/15 EPGO265

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





Calibration Date: 10/12/2015

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.





Ref: ACR.299.1.15.SATU.A

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	10/26/2015	JES
Checked by:	Jérôme LUC	Product Manager	10/26/2015	75
Approved by:	Kim RUTKOWSKI	Quality Manager	10/26/2015	them that thousand

	Customer Name	
	SHENZHEN	
	BALUN	
Distribution:	TECHNOLOGY	
	Co.,Ltd.	

Issue	Date	Modifications
A	10/26/2015	Initial release
		- D

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Ref: ACR.299.1.15.SATU.A

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Ref: ACR.299.1,15.SATU.A

1 DEVICE UNDER TEST

Device Under Test				
Device Type	COMOSAR DOSIMETRIC E FIELD PROBE			
Manufacturer	MVG			
Model	SSE2			
Serial Number	SN 34/15 EPGO265			
Product Condition (new / used)	New			
Frequency Range of Probe	0.45 GHz-6GHz			
Resistance of Three Dipoles at Connector	Dipole 1: R1=0.192 MΩ			
	Dipole 2: R2=0.230 MΩ			
	Dipole 3: R3=0.205 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	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, 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.

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Ref: ACR.299.1.15.SATU.A

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.

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%

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Ref: ACR.299.1,15.SATU.A

Field probe linearity	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Combined standard uncertainty				- 4	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 %			

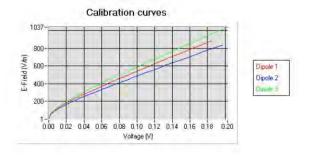
5.1 SENSITIVITY IN AIR

	Normy dipole $2 (\mu V/(V/m)^2)$	
0.72	0.81	0.85

DCP dipole 1	DCP dipole 2	DCP dipole 3	
(mV)	(mV)	(mV)	
92	90	95	

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

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



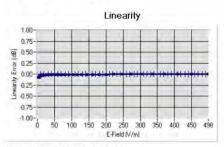
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Ref: ACR.299.1.15.SATU.A

5.2 LINEARITY



Linearity: (1+/-1.61% (+/-0.07dB)

5.3 SENSITIVITY IN LIQUID

Liquid	Frequency (MHz +/- 100MHz)	Permittivity	Epsilon (S/m)	ConvF
HL450.	450	44.12	0.88	1.85
BL450	450	58.92	1.00	1.90
HL750	750	42.24	0.90	1.81
BL750	750	56.85	0.99	1.88
HL850	835	43.02	0.90	2.04
BL850	835	53.72	0,98	2.12
HL900	900	42.47	0.99	1.86
BL900	900	56.97	1.09	1.92
HL1800	1800	42.24	1.40	2.04
BL1800	1800	53.53	1.53	2.08
HL1900	1900	40.79	1.42	2.35
BL1900	1900	54.47	1.57	2.42
HL2000	2000	40.52	1.44	2.23
BL2000	2000	54.18	1.56	2.32
HL2450	2450	38.73	1.81	2.47
BL2450	2450	53.23	1,96	2.55
HL2600	2600	38.54	1.95	2.36
BL2600	2600	52.07	2.23	2.43
HL5200	5200	36.80	4.84	1.81
BL5200	5200	51.21	5.16	1.85
HL5400	5400	36.35	4.96	2.04
BL5400	5400	50.51	5.70	2.11
HL5600	5600	35.57	5.23	2.08
BL5600	5600	49.83	5,91	2.15
HL5800	5800	35.30	5,47	1.88
BL5800	5800	49.03	6.28	1.93

LOWER DETECTION LIMIT: 7mW/kg

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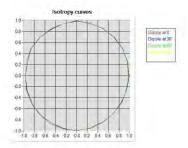


Ref: ACR.299.1.15.SATU.A

5.4 ISOTROPY

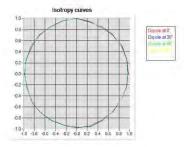
HL900 MHz

- Axial isotropy: 0.04 dB - Hemispherical isotropy: 0.06 dB



HL1800 MHz

- Axial isotropy: 0.04 dB - Hemispherical isotropy: 0.06 dB



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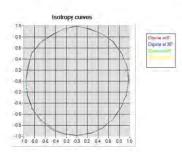




Ref: ACR.299.1.15.SATU.A

HL5600 MHz

- Axial isotropy: 0.06 dB - Hemispherical isotropy: 0.09 dB



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Ref: ACR.299.1.15.SATU.A

6 LIST OF EQUIPMENT

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 ca required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No ca required.
Network Analyzer	Rhode & Schwarz ZVA	SN100132	02/2013	02/2016
Reference Probe	MVG	EP 94 SN 37/08	10/2015	10/2016
Multimeter	Keithley 2000	1188656	12/2013	12/2016
Signal Generator	Agilent E4438C	MY49070581	12/2013	12/2016
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required
Power Meter	HP E4418A	US38261498	12/2013	12/2016
Power Sensor	HP ECP-E26A	US37181460	12/2013	12/2016
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.

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F.2 750 MHz Dipole



SAR Reference Dipole Calibration Report

Ref: ACR.75.7.15.SATU.A

SHENZHEN BALUN TECHNOLOGY CO.,LTD.

BLOCK B, FL 1, BAISHA SCIENCE AND TECHNOLOGY PARK, SHAHE XI ROAD,

NANSHAN DISTRICT, SHENZHEN, GUANGDONG PROVINCE, P.R. CHINA 518055

MVG COMOSAR REFERENCE DIPOLE

FREQUENCY: 750 MHZ

SERIAL NO.: SN 25/13 DIP 0G750-253

Calibrated at MVG US

2105 Barrett Park Dr. - Kennesaw, GA 30144



03/16/2015

Summary:

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





SAR REFERENCE DIPOLE CALIBRATION REPORT

RECAURAGE TELESCOPE A

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	3/16/2015	JE
Checked by z	Jérôme LUC	Product Manager	3/16/2015	75
Approved by:	Kim RUTKOWSKI	Quality Manager	3/16/2015	Ann Vorteral

	Castomer Name
Distribution:	SHENZHEN
	BALUN
	TECHNOLOGY
	Co.,Ltd.

Issue	Date	Modifications
A	3/16/2015	Initial release

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ret: ACR-75.1 (5.5A)T. A.

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ret: ACR: 75.1 15.5 A1T. 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 750 MHz REFERENCE DIPOLE	
Manufacturer	MVG	
Model	SID750	
Serial Number	SN 25/13 DIP 0G750-253	
Product Condition (new / used)	Used	

A yearly calibration interval is recommended.

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

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



Figure 1 - MVG COMOSAR Validation Dipole

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4 MEASUREMENT METHOD

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

4.1 RETURN LOSS REQUIREMENTS

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

4.2 MECHANICAL REQUIREMENTS

The IEEE Std. 1528 and CEFIEC 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.

Expanded Uncertainty on Return Loss
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 CELIEC 62209 standards were followed to generate the measurement uncertainty for validation measurements.

Scan Volume	Expanded Uncertainty
1 g	20.3 %

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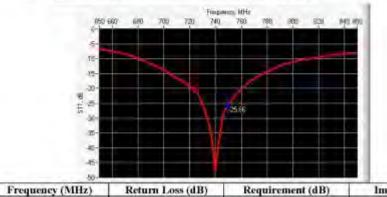


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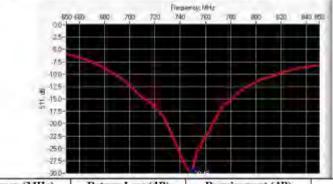
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



| Frequency (MHz) | Return Loss (dB) | Requirement (dB) | Impedance | 750 | -25.86 | -20 | 54.5 Ω - 2.7 jΩ

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
750 -29.45		-20	52.6 Ω + 2.3 jΩ

6.3 MECHANICAL DIMENSIONS

Frequency MH2	Le	nem	hm	im	di	mm
	required	measured	required	measured	required	measured
300	420.0 ±1 %.		250.0 ±1%		6.35 ±1 %.	

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450	290.0 ±1 %.		166.7±1%.		5.35±1%	
750	176,0±1 %	PASS	100,0±1%.	PASS	6.35 ±1 %	PASS
855	161.0±1 %.		89.8 ±1 1/4		3.6±1%	
900	149.0 ±1 %.		83.3 :1 %		3.6 :1%	
1450	89.1 ±1 %;		51.7 ±1%		3.6 21 %.	
1500	80.5±1%		50,0:1%		1.6±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 21%	
1900	68.0±1%		39.5 ±1 %		3.6±1%	
1950	66.3 ±1.W.		38.5 ±1.34		3.6 ±154	
2000	64.5 £1 %.		37 S #1 %		3.6 ±1 %	
2100	61.0±1%		35.7 ±1 %		3.6 :1%.	
2300	55,5 ±1 %.		32.6 11.%		3.6 ±1%	
2450	51.5 ±1 %		30,441%		3.6 ±1%.	
2600	185±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±19L	
3700	34.7±1 %.		26.4 ±1 %		3.6 91%	

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

MH2	Relative per	mittivity (s.')	Conductly	ity (a) S/m
	regulred	measured	required	measured
300	45.3.15/6		0.8715%	
450	43.5 ±5 %		0.87±5%	
750	41.9 ±5 %	PASS	0.89 ±5 %	PASS
835	41.5 ±5%		0.90±5 N	
900	W1,5±5%		0.97 ±5 %	
1450	40.5 ±5 %		1.20 +5 %	
1500	40.4 15 16		1.23 15 %	
1640	40.2 ±5 %		1.31 ±5 %	
1750	40.1 ±5 %		1.37 ±5 %	

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1800	40.0 ±5 %	1.40 ±5 %
1900	40.0 ±5 %	1.40 ±5 %
1950	40.0 ±5 %	1.40 ±5 %
2000	40.0 ±5 %	1.40 ±5 %
2100	39.8 ±5 %	1.49 ±5 %
2300	39.5 ±5 %	1,67 ±5 %
2450	39.2 ±5 %	1.80 ±5 %
2600	39.0 ±5 %	1.96 ±5 %
3000	38.5 ±5 %	2.40 ±5 %
3500	37.9 ±5 %	2.91 ±5 %

7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

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

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Head Liquid Values: eps': 41.8 sigma: 0.90
Distance between dipole center and liquid	15.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=8mm/dy=8m/dz=5mm
Frequency	750 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

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	8.60 (0.86)	5.55	5.65 (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	D	20.1	

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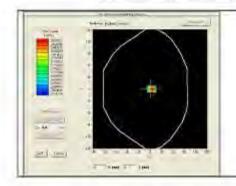
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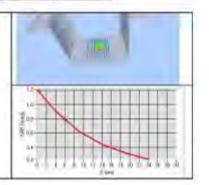




Ret: AUR. 75.1 (5.SA)T. A.

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

MHz.	Relative nermittivity (c.)		Conductiv	ity (a) \$/m
	required	measured	required	measured
150	61.9 ±5.56		0.80 ±5 %	
300	58.2 ±5 %	Time to	0.92 ±5%	
450	56.7±5%		0.94 ±5 %	
750	55.5 ±5 %	PASS	0.96 ±5 %	PASS
835	55.2 ±5 %		0.97 ±5 %	
900	55.0 ±5 %		1.05 ±5 %	
915	55.0 ±5 %		1.06±5%	
1450	54.0 ±5 %		1.30±5%	
1610	53.8 ±5 %		1.40 ±5 %	
1800	53.3 ±5 %		1.52 ±5 %	
1900	53.3 ±5 %		1.52 ±5 %	
2000	53.3 ±5.%		1,52 ±5 %	
2100	53.2 ±5 %		1.62 ±5 %	
2450	52.7 ±5 %		1.95 ±5 %	

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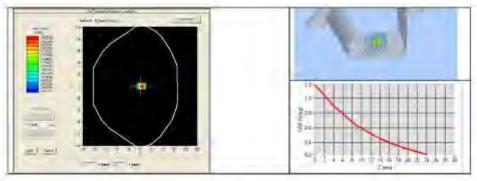
Ret: ACR. 75.1 (5.SA)(1). A

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 56.3 sagma : 0.98
Distance between dipole center and liquid	15.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx-8mm/dy-8m/dz-5mm
Frequency	750 MHz.
Input power	20 dBm
Liquid Temperature	21°C
Lab Temperature	21 °C
Lab Hemidity	45%

Frequency MHz	1 g SAR (W/kg/W)	10 g SAR (W/kg/W)	
	measured	measured	
750	8.91 (0.89)	5.91 (0.59)	



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Ref. AUR.75.1 (5.5A)(1).A.

8 LIST OF EQUIPMENT

	Equ	pment Summary S	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 ca required	
COMOSAR Test Bench	Version 3	NA	Validated. No call required.	Validated No ca required	
Network Analyzer	Rhode & Schwarz ZVA	SN100132	02/2013	02/2016	
Calipers	Carrera	CALIPER-01	12/2013	12/2016	
Reference Probe	MVG	EPG122.SN 18/11	10/2014	10/2015	
Multimeter	Keithley 2000	1188656	12/2013	12/2016	
Signal Generator	Agilent E4438C	MY49070531	12/2013	12/2016	
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required,	Characterized prior to test. No cal required	
Power Meter	HP E4416A	US38261498	12/2013	12/2016	
Power Sensor	HP ECP-E26A	US37181460	12/2013	12/2016	
Directional Coupler	Nardá 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required	
Temperature and Humidity Sensor	Control Company	11-661-9	8/2012	B/2015	

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F.3 835MHz Dipole



SAR Reference Dipole Calibration Report

Ref : ACR.75.8.15.SATU.A

SHENZHEN BALUN TECHNOLOGY CO.,LTD.

BLOCK B, FL 1, BAISHA SCIENCE AND TECHNOLOGY PARK, SHAHE XI ROAD,

NANSHAN DISTRICT, SHENZHEN, GUANGDONG PROVINCE, P.R. CHINA 518055

MVG COMOSAR REFERENCE DIPOLE

FREQUENCY: 835 MHZ

SERIAL NO.: SN 25/13 DIP 0G835-246

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



03/16/2015

Summary:

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





RECACE TERMS SAID A

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	3/16/2015	JS
Checked by z	Jerôme LUC	Product Manager	3/16/2015	JS
Approved by:	Kim RUTKOWSKI	Quality Manager	3/16/2015	Ann Vorterous

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	TECHNOLOGY
	Co.,Ltd.

Issue	Date	Modifications
A	3/16/2015	Initial release

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1 INTRODUCTION

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

2 DEVICE UNDER TEST

D	evice Under Test
Device Type	COMOSAR 835 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID835
Serial Number	SN 25/13 DIP 0G835-246
Product Condition (new / used)	Used

A yearly calibration interval is recommended.

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

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



Figure 1 - MVG COMOSAR Validation Dipole

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4 MEASUREMENT METHOD

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

4.1 RETURN LOSS REQUIREMENTS

The dipole used for SAR system validation measurements and checks must have a return loss of -20 dB or better. The return loss measurement shall be performed against a liquid filled that 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:

Expanded Uncertainty on Length
0.05 mm

5.3 VALIDATION MEASUREMENT

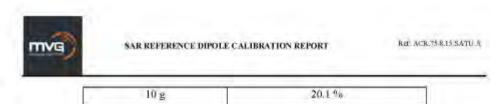
The guidelines outlined in the IEEE 1528, FCC KDBs, CENELEC EN50361 and CEDIEC 62209 standards were followed to generate the measurement uncertainty for validation measurements.

Scan Volume	Expanded Uncertainty
1 g	20.3 %

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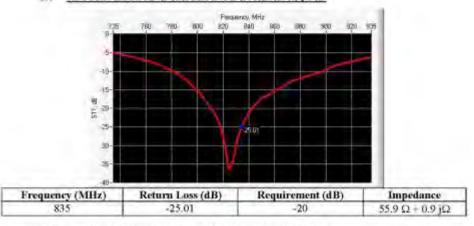
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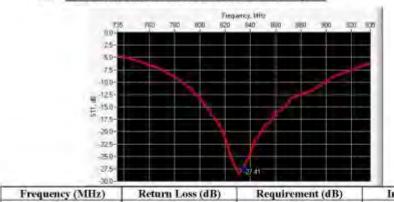


6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
835	-27.41	-20	52.1 Ω + 3.8 jΩ

6.3 MECHANICAL DIMENSIONS

Frequency MH2	10	^m	hm	int	di	d mm	
	required	measured	required	measured	required	measured	
300	420.0 ±1 %		250.0 ±1 %		5.35 p1 %		

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450	290.0 ±1 %.		166.7±1%.		635±1%	
750	176,0±1 %		100,0±1%.		6.35 ±1%	
855	161.0±1 %.	PASS	89.8 ±1 1/4	PASS	3.6±1%	PASS
900	149,0 ±1 %.		83.3 :1%		3.6 :1%	
1450	89.1 ±1 %.		51.7 ±1%		3.6 21 %.	
1500	80.5±1%		50,0:1%		3.6±1%.	
1640	79.0 +1 %.		45.7±1%		3.5 ±1 %	
1750	75.2 ±1 %.		42,9 ±1 %		3.6 ±1%	
1800	72.0±1%		41.711%		3,6 21%	
1900	68.0±1%		39.5±1.%		3.6±1/%	
1950	66.3 ±1.%		38.5 ±1.34		3.6 ±154	
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 11.%		3.6 ±1%	
2450	51.5 ±1 %		30,441 %		3.6 ±1%.	
2600	185±1%		28.8 ±1%		3.6:1%	
3000	41.5 ±1%		25.0 ±1.%		3.6:1%	
3500	37 0±1 H.		26.4±1 %		3.6±19L	
3700	34.7±1 %.		26.4 ±1 %		3.6 91%	

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 I HEAD LIQUID MEASUREMENT

Triequency Tribliz	Relative permittivity (s.')		Conductivity (a) S/m	
	regulred	measured	required	measured
300	45.3.15.76		0.8715%	
450	43.5 ±5 %		0.87 ±5 %	
750	41,9 ±5 %		0.89 ±5 %	
835	41.5 ±5%	PASS.	0.50±5 N	PASS.
900	W1.5±5%		0.97 ±5 %	
1450	40.5 ±5 %		1.20+5%	
1500	40.4 45 %		1.23 15 %	
1640	40.2 ±5 %		1.31 ±5 %	
1750	40.1 ±5 %		1.37 ±5 %	

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1800	40.0±5%	1.40 ±5 %
1900	40,0 ±5 %	1,40 ±5 %
1950	40,015%	1,40 ±5 %
2000	40.0 ±5 %	1.40.15%
2100	39.8 ±5.14	1,49 ±5%
2300	39.5 ±5 %	1.67 ±5 %
2450	39,2±5%	180±5%
2600	39.0'±5.5\	1.96.15 %
3000	38.5 ±5 %	2,40±5%
3500	37.9 45 %	2.91.45 W

7.2 SAR MEASUREMENT RESULT WITH READ LIQUID

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

Software	OPENSAR V4	
Phantom	SN 20/09 SAM71	
Probe	SN 18/11 EPG122	
Liquid	Head Liquid Values: eps. 42.1 sigma . 0.92	
Distance between dipole center and liquid	15,0.mm	
Area scan resolution	dx-8mm/dy-8mm	
Zoen Scan Resolution	dx 8mm/dy 8m/dz 5mm	
Frequency	835 MHz	
Input power	20 JFm	
Liquid Temperature	21°C	
Lab Temperature	21°C	
Lab Humidity	35 to	

Frequency	1 g SAR (W/kg/W)		10 g SAB (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	9.81 (0.98)	6.22	6.37 (0.63)
900	10,9	-	6.99	-
3450	29		16	
1500	30,5		16.8	
1640	34.2		18.4	
1750	36,4		19.3	
3.800	38,4		20.1	

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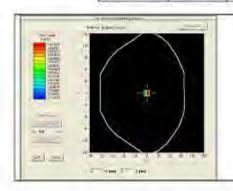
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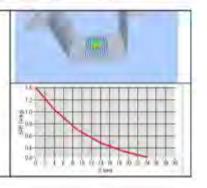




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1900	39.7	20.5
3950	40.5	20.9
2000	41,1	21.1
2100	.43.6	21.9
2300	48.7	23.3
2450.	52.4	24
2600	55.3	24,6
3000	63.8	25.7
3500	67,1	25





7.3 BODY LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (c.')		Conductivity (a) S/m	
	required	measured	required	measured
150	61.9 ±5.%		0.80 ±5 %	-
300	58.2 ±5 %		0.92 ±5%	
450	56.7 ±5 %		0.94 ±5 %	
750	55.5 ±5 %		0.96 ±5 %	
835	55.2 ±5 %	PASS	0.97 ±5 %	PASS.
900	55.0 ±5 %		1.05 ±5 %	
915	55.0 ±5 %		1.06±5%	
1450	54.0 ±5 %		1.30±5%	-
1610	53.8 ±5 %		1.40 ±5 %	
1800	53.3 ±5 %		1.52 ±5 %	
1900	53.3 ±5 %		1.52 ±5 %	
2000	53.3 ±5.%		1,52 ±5 %	
2100	53.2 ±5 %		1.62 ±5 %	
2450	52.7 ±5 %		1.95 ±5 %	

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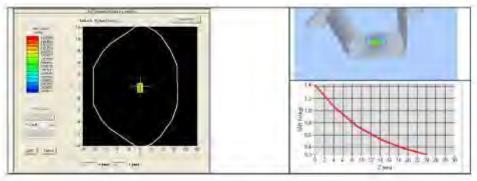
Ret: AUR. 75.8.15. SAIT! A

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 ±10.16	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 53:8 sagma: 0.98
Distance between dipole center and liquid	15.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=8mm/dy=8m/dz=5mm
Frequency	835 MHz
Input power	20 dBm
Liquid Temperature	21°C
Lab Temperature	21 °C
Lab Humidity	45 %

Frequency MHz	1 g SAR (W/kg/W)	10 g SAR (W/kg/W)
	measured	measured
835	10.53 (1.05)	6.89 (0.69)



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8 LIST OF EQUIPMENT

Equipment	Manufacturer/	Identification No.	Current	Next Calibration		
Description	Model	Identification 1907	Calibration Date	Date		
Description SAM Phantom COMOSAR Test Bench Network Analyzer Calipers Reference Probe Multimeter Signal Generator	MVG	SN-20/09-SAM71	Validated. No cal required.	Validated No ca required		
COMOSAR Test Bench	Version 3	NA	Validated. No call required.	Validated No ca required		
Network Analyzer	Rhode & Schwarz ZVA	SN100132	02/2013	02/2016		
Calipers	Carrera	CALIPER-01	12/2013	12/2016		
Reference Probe	MVG	EPG122.SN 18/11	10/2014	10/2015		
Mutimeter	Keithley 2000	1188656	12/2013	12/2016		
Signal Generator	Agilent E4438C	MY49070531	12/2013	12/2016		
Amplifier	Aetheroomm	SN 046	Characterized prior to test. No cal required,	Characterized prior to test. No cal required.		
Power Meter	HP E4416A	US38261498	12/2013	12/2016		
Power Sensor	HP ECP-E26A	US37181460	12/2013	12/2016		
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required		
Temperature and Humidity Sensor	Control Company	11.661-9	8/2012	8/2015		

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F.4 1800MHz Dipole



SAR Reference Dipole Calibration Report

Ref: ACR.75.10.15.SATU.A

SHENZHEN BALUN TECHNOLOGY CO.,LTD.

BLOCK B, FL 1, BAISHA SCIENCE AND TECHNOLOGY PARK, SHAHE XI ROAD,

NANSHAN DISTRICT, SHENZHEN, GUANGDONG PROVINCE, P.R. CHINA 518055

MVG COMOSAR REFERENCE DIPOLE

FREQUENCY: 1800 MHZ

SERIAL NO.: SN 25/13 DIP 1G800-248

Calibrated at MVG US

2105 Barrett Park Dr. - Kennesaw, GA 30144





03/16/2015

Summary:

This document presents the method and results from an accredited SAR reference dipote colubration performed in MVO USA using the COMOSAR test bench. All calibration results are traceable to rational metrology institutions.





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	Name	Function	Date	Signature
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Checked by z	Jérôme LUC	Product Manager	3/16/2015	JS
Approved by:	Kim RUTKOWSKI	Quality Manager	3/16/2015	Man Voite and

	Customer Name		
	SHENZHEN		
the section	BALUN		
Distribution:	TECHNOLOGY		
	Co.,Ltd.		

Issue	Date	Modifications
A	3/16/2015	Initial release
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1 INTRODUCTION

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

2 DEVICE UNDER TEST

Device Under Test				
Device Type	COMOSAR 1800 MHz REFERENCE DIPOLE			
Manufacturer	MVG			
Model	SID1800			
Serial Number	SN 25/13 DIP 1G800-248			
Product Condition (new / used)	Used			

A yearly calibration interval is recommended.

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

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



Figure 1 - MVG COMOSAR Validation Dipole

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4 MEASUREMENT METHOD

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

4.1 RETURN LOSS REQUIREMENTS

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

4.2 MECHANICAL REQUIREMENTS

The IEEE Std. 1528 and CEUEC 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.

Expanded Uncertainty on Return Los		
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 CELIEC 62209 standards were followed to generate the measurement uncertainty for validation measurements.

Scan Volume	Expanded Uncertainty		
1 g	20.3 %		

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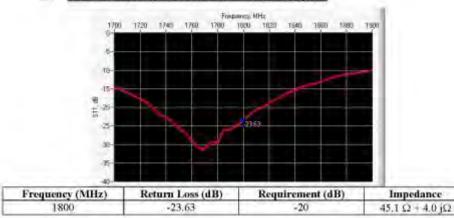


Ref: ACR.75.10 15.SATU A

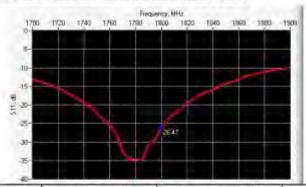


6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance 45.5 Ω - 0.3 jΩ	
1800	-26.47	-20		

6.3 MECHANICAL DIMENSIONS

Frequency MH2	Limm		it mim		d mm	
	required	measured	required	measured	required	measured
300	420.0 ±1 %.		250.0 ±1 %		6.35 ±1 %.	

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Res: ACR-75-10 (5-54)T/ A

450	290.0 ±1 %		166.7±1%.		6.35±1%	
750	176,0±1 %		100,0±1%.		6.35 ±1%	
855	161/0±1 %.		89.8 ±1 1/4		3.6±1%	
900	149.0 ±1 %.		83.3 ±1 %		3.6 21%	
1450	89.1 ±1 %;		51.7±1%		3.6 21 %.	
1500	80.5±1%		50,0:1%		1.6±1%.	
1640	79.0+1%.		45.7±1 %		3.5±1%	
1750	75.2 ±1 %.		42,9 ±1 %		3.6 ±1%	
1800	72.0±1%	2889	41.711%	PASS	3.6:21%	PAS
1900	68.0±1%		39.5 ±1.%		3.6±1/%	
1950	66.3±1%		38.5 ±1.34		3.6 ±1.54	
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 11.%		3.6 ±1%	
2450	51.5 ±1 %.		30,441 %		3.6 ±1%.	
2600	185±1%		28.8 ±1%		3.6:1%	
3000	41.5 ±1%		25,0 ±1 %		3.6 ±1 %	
3500	37 0±1 H.		26.4±1 %		3.6±19L	
3700	34.7±1 %.		26.4 ±1 %		3.6 91%	

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

MH2	Relative permittivity (s.')		Conductivity (a) S/m	
	regulred	measured	required	measured
300	45.3.15.76		0.8715%	
450	43.5 ±5 %		0.87±5%	
750	41.9 ±5 %		0.89 ±5 %	
835	41.5 ±5%		0.50±5 %	
900	W1,5±5%		0.97 ±5 %	
1450	40.5 ±5 %		1.20 ±5 %	
1500	40.4 15 16		1.23 15 %	
1640	40.2 ±5 %		1.31 ±5 %	
1750	40.1 ±5 %		1.37 ±5 %	

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Ret ACR-75-10 (\$ 5-k1) A

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 %		1.40.15%	
2100	39.8 ±5.14		1,49 :5%	
2300	39.5 ±5 %		1.67±5%	
2450	39,2±5\		180±5%	
2600	39.0'±5.W		1.8645%	
3000	38,5 ±5 %		2,40+5%	
3500	37.9 45 %		2.92.45 %	

7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

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

Software	OPENSAR V4	
Phantom	SN 20/09 SAM71	
Probe	SN 18/11 EPG122	
Liquid	Head Liquid Values: eps. 41.1 sigma . 139	
Distance between dipole center and liquid	10.0 mm	
Area soan resolution	dx-Smm dy-Smm	
Zoen Scan Resolution	dx-8mm/dy-8m/dz-5mm	
Frequency:	1800 MHz	
Input power	/20 JEHm	
Liquid Temperature	21°C	
Lab Temperature	21.00	
Lab Humidity	35 %	

Frequency	1 g SAR	(W/kg/W)	10 g 5AR	(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	
3,800	38,4	38.72 (3.87)	20.1	20.37 [2.04]

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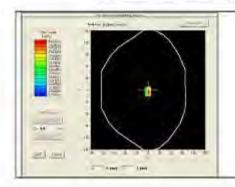
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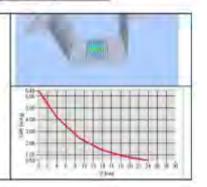




Res: ACR.75-10 15.SATT. A.

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 per	mittivity (c.')	Conductiv	ity (a) S/m
	required	measured	required	measured
150	61.9 ±5.56		0.80 ±5 %	
300	58.2 ±5 %		0.92 ±5%	
450	56.7 ±5 %		0.94 ±5 %	
750	55.5 ±5 %		0.96 ±5 %	
835	55.2 ±5 %		0.97 ±5 %	
900	55.0 ±5 %		1.05 ±5 %	
915	55,0 ±5 %		1.06±5%	
1450	54.0 ±5 %		1.30±5%	
1610	53.8 ±5 %		1.40 ±5 %	
1800	53.3 ±5 %	PASS	1.52 ±5 %	PASS
1900	53.3 ±5 %		1.52 ±5 %	
2000	53.3 ±5.%		1.52 ±5 %	
2100	53.2 ±5 %		1.62 ±5 %	
2450	52.7 ±5 %		1.95 ±5 %	

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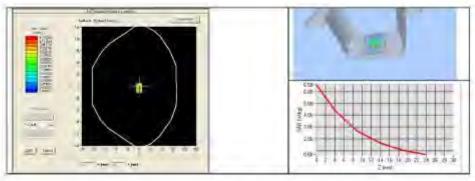
Res: ACR.75-10 15.SATU-A

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 sagma,: 1.52	
Distance between dipole center and liquid	10.0 mm	
Area scan resolution	dx=8mm/dy=8mm	
Zoon Scan Resolution	dx=8mm/dy=8m/dz=5mm	
Frequency	1800 MHz	
Input power	20 dBm	
Liquid Temperature	21°C	
Lab Temperature	21 °C	
Lab Hemidity	43 %	

Frequency MHz	1 g SAR (W/kg/W)	10 g SAR (W/kg/W)
	measured	measured
1800	40.42 (4.04)	21.53 (2.15)



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Rat: ACR-75-10 (5-5-k)T/-A-

8 LIST OF EQUIPMENT

	Equi	pment Summary S	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 ca required
COMOSAR Test Bench	Version 3	NA	Validated. No call required.	Validated No ca required
Network Analyzer	Rhode & Schwarz ZVA	SN100132	02/2013	02/2016
Calipers	Carrera	CALIPER-01	12/2013	12/2016
Reference Probe	MVG	EPG122.SN 18/11	10/2014	10/2015
Mutimeter	Keithley 2000	1188656	12/2013	12/2016
Signal Generator	Agilent E4438C	MY49070581	12/2013	12/2016
Amplifier	Aetheroomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required
Power Meter	HP E4416A	US38261498	12/2013	12/2016
Power Sensor	HP ECP-E26A	US37181460	12/2013	12/2016
Directional Coupler	Narga 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required
Temperature and Humidity Sensor	Control Company	11-661-9	8/2012	B/2015

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F.5 1900MHz Dipole



SAR Reference Dipole Calibration Report

Ref: ACR:75.11.15,SATU.A

SHENZHEN BALUN TECHNOLOGY CO.,LTD. BLOCK B, FL 1, BAISHA SCIENCE AND TECHNOLOGY PARK, SHAHE XI ROAD, NANSHAN DISTRICT, SHENZHEN, GUANGDONG PROVINCE, P.R. CHINA 518055

MVG COMOSAR REFERENCE DIPOLE

FREQUENCY: 1900 MHZ SERIAL NO.: SN 25/13 DIP 1G900-249

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



03/16/2015

Summary:

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





ROS ACR. 75.1 L 15 SAITU A.

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	3/16/2015	JE
Checked by z	Jérôme LUC	Product Manager	3/16/2015	JS
Approved by:	Kim RUTKOWSKI	Quality Manager	3/16/2015	Ann Voiteral

	Customer Name
Distribution:	SHENZHEN
	BALUN
	TECHNOLOGY
	Co.,Ltd.

Issue	Date	Modifications
A	3/16/2015	Initial release
-0.0		

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Ref: ACR. 75.11.15 (SACIT) A.

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ROS ACR. 75.11.15.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 25/13 DIP 1G900-249				
Product Condition (new / used)	Used				

A yearly calibration interval is recommended.

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

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



Figure 1 - MVG COMOSAR Validation Dipole

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Rate ACR-75-11-15-5-A1T/-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 fiquid filled that phantom, with the phantom constructed as outlined in the fore mentioned standards.

4.2 MECHANICAL REQUIREMENTS

The IEEE Std. 1528 and CEDEC 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 Los		
400-6000MHz	0.1 dB		

5,2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

Expanded Uncertainty on Length		
0.05 mm		

5.3 VALIDATION MEASUREMENT

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

Scan Volume	Expanded Uncertainty		
1 g.	20.3 %		

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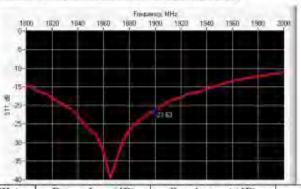


ROE ACR. 75.11.15 SATULA

10 g	20.1 %	

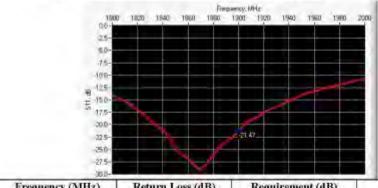
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



| Frequency (MHz) | Return Loss (dB) | Requirement (dB) | Impedance | 1900 | -21.63 | -20 | 53.9 Ω + 7.7 jΩ

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
1900	-21.47	-20	$48.9 \Omega + 8.4 i\Omega$

6.3 MECHANICAL DIMENSIONS

Frequency MH2	uency MH2 L mm		Br mim		d mm	
	required	measured	required	measured	required	measured
300	420.0 ±1 %.		250.0 ±1%		6.35 ±1 %.	

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450	290.0 ±1 %		166.7±156.		6.35±1%	
750	176,0±1 %		100,0±1%.		6.35 ±1%	
855	161/0±1 %.		89.8 ±1 1/4		3.6±1%	
900	I49.0 ±1 %.		83.3±1%		3.6 21%	
1450	89.1 ±1 %		51.7±1%		3.6 21 %.	
1500	80.5±1%		50,0:1%		1.6±1%.	
1640	79.0 +1 %		45.7±1%		3.5 ±1 %	
1750	75,2 ±1 %		42,9 ±1 %		3.6 ±1%	
1800	72.0±1%		41.711%		3.6 21%	
1900	68.0±1%	PASS	39.5±1.%	PASS	3.6±1%.	PASS
1950	66.3 ±1 W		38.5 ±1.34		3.6 ±154	
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 11.%		3.6 ±1%	
2450	51.5±1 %.		30,441%		3.6 ±1%.	
2600	185±1%		28.8 ±1%		3.6:1%	
3000	41.5 ±1%.		25.0 ±1.%		3.6:1%	
3500	37 0±1 H.		26.4±1 %		3.6±1.9L	
3700	34.7±1 %.		26.4 ±1 %		3.6 91%	

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 I HEAD LIQUID MEASUREMENT

Frequency MH2	Relative per	mitthvity (s.')	Conductivity (a) S/m		
	regulred	measured	required	measured	
300	45.3.15.76		0.8715.%		
450	43.5 15 %		0.87 ±5 %		
750	41,9 ±5 %		0.89 ±5 %		
835	41.5 ±5%		0.50±5 N		
900	W1,5±5%		0.97 ±5 %		
1450	40.5 ±5 %		1.20+5%		
1500	40.4 45 %		1.23 15 %		
1640	40.2±5%		1.31 ±5 %		
1750	40.1 ±5 %		1.37 ±5 %		

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Rat: ACR-75.11.15.5A71/A:

1800	40.0 ±5.%		1.40 ±5 %	
1900	40.0 ±5 %	PASS	1,40 ±5 %	PASS
1950	40,015%		1,40 ±5 %	
2000	40.0 ±5 %		1.40.15%	
2100	39.8 ±5.14		1,49 :5%	
2300	39.5±5 × 1.67±5 ×			
2450	38,2±5% 1.80±5%			
2600	39.0/±5.W	39.0±5.0(1.96±5%		
3000	38.5 ±5 % 2.40 ±5 %			
3500	37.9 45 %		2.90,45 %	

7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

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

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Head Liquid Values: eps. 40.9 sigma, 1.43
Distance between dipole center and liquid	10.0:mm
Area scan resolution	dx-8mm/dy-8mm
Zoen Scan Resolution	dx-8mm/dy-8m/dz-5mm
Frequency	1900 MHz
Input power	/20 dFlm
Liquid Temperature	21°C
Lab Temperature	21 °C
Lab Humidity	45 to

Frequency	1 g SAR (W/kg/W)		10 g SAB (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		
3450	29 16		16	16	
1500	30,5		16.8		
1640	34.2		18.4		
1750	36.4		19.3		
3,800	38,4		20.1		

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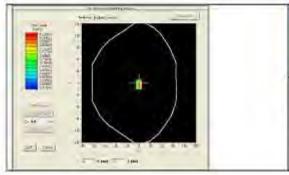
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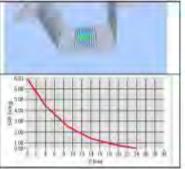




Res: ACR.75.11.15.SACIU A

1900	39.7	40.75 (4.08)	20.5	20.82 (2.08)
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	1





7.3 BODY LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (c.')		Conductivity (a) S/m	
	required	measured	required	measured
150	61.9 ±5.56	-	0.80 ±5 %	
300	58.2 ±5 %		0.92 ±5%	
450	56.7 ±5 %		0.94 ±5 %	
750	55.5 ±5 %		0.96 ±5 %	
835	55.2 ±5 %		0.97 ±5 %	
900	55.0 ±5 %		1.05 ±5 %	
915	55.0 ±5 %	55,0 ±5 %		
1450	54.0 ±5 %		1.30±5%	_
1610	53.8 ±5 %		1.40 ±5 %	
1800	53.3 ±5 %		1.52 ±5 %	
1900	53.3 ±5 %	PASS	1.52 ±5 %	PASS
2000	53.3 ±5.%		1.52 ±5 %	
2100	53.2 ±5 %		±5 % 1.62 ±5 %	
2450	52.7 ±5 %		1.95 ±5 %	

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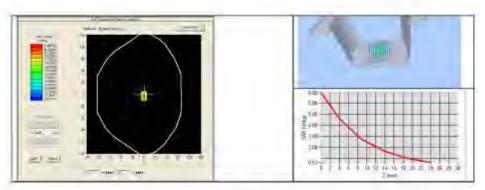
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52.5 ±5 %	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
AL 14 (10 - 10)	2.16±5%
52.0 ±5 %	2.73 ±5 %
51,3 ±5 %	3.31 ±5 %
9.0±10%	5.30±10%
48.9 ±10%	5.42 ±10 %
48.7±10%	5.53±10 %
48.6 ±10 %	5,65 ±10 %
48.5 ±10 %	5.77±10%
48.2±10%	6,00±10%
	8.6 ±10 % 8.5 ±10 %

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 53.9 sigma: 1.55	
Distance between dipole center and liquid	10.0 mm	
Area scan resolution	dx=8mm/dy=8mm	
Zoon Scan Resolution	dx-8mm/dy-8m/dz-5mm	
Frequency	1900 MHz	
Input power	20 dBm	
Liquid Temperature	21°C	
Lab Temperature	21 C	
Lab Humidity	43 %	

Frequency MHz	1 g SAR (W/kg/W)	10 g SAR (W/kg/W)
	measured	measured
1900	(2.05 (4.21)	21.87 (2.19)



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Rate ACR-75.11.15 SAUTU A:

8 LIST OF EQUIPMENT

	Equi	pment Summary S	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 ca required
COMOSAR Test Bench	Version 3	NA	Validated. No call required.	Validated No ca required
Network Analyzer	Rhode & Schwarz ZVA	SN100132	02/2013	02/2016
Calipers	Carrera	CALIPER-01	12/2013	12/2016
Reference Probe	MVG	EPG122.SN 18/11	10/2014	10/2015
Multimeter	Keithley 2000	1188656	12/2013	12/2016
Signal Generator	Agilent E4438C	MY49070531	12/2013	12/2016
Amplifier	Aetheroomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required
Power Meter	HP E4416A	US38261498	12/2013	12/2016
Power Sensor	HP ECP-E26A	US37181460	12/2013	12/2016
Directional Coupler	Nardá 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required
Temperature and Humidity Sensor	Control Company	11-661-9	8/2012	B/2015

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F.6 2450MHz Dipole



SAR Reference Dipole Calibration Report

Ref: ACR.75.13.15.SATU.A

SHENZHEN BALUN TECHNOLOGY CO.,LTD.

BLOCK B, FL 1, BAISHA SCIENCE AND TECHNOLOGY PARK, SHAHE XI ROAD,

NANSHAN DISTRICT, SHENZHEN, GUANGDONG PROVINCE, P.R. CHINA 518055

MVG COMOSAR REFERENCE DIPOLE

FREQUENCY: 2450 MHZ

SERIAL NO.: SN 25/13 DIP 2G450-251

Calibrated at MVG US

2105 Barrett Park Dr. - Kennesaw, GA 30144





03/16/2015

Summary:

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





Ref: ACR. 73 13 15 SATUAL

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	3/16/2015	15
Checked by z	Jérôme LUC	Product Manager	3/16/2015	JS
Approved by:	Kim RUTKOWSKI	Quality Manager	3/16/2015	April Vinterration

	Customer Name
	SHENZHEN
Distribution :	BALUN TECHNOLOGY
	Co.,Ltd.

Issue	Date	Modifications
A	3/16/2015	Initial release

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1 INTRODUCTION

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

2 DEVICE UNDER TEST

D	evice Under Test
Device Type	COMOSAR 2450 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID2450
Serial Number	SN 25/13 DIP 2G450-251
Product Condition (new / used)	Used

A yearly calibration interval is recommended.

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

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



Figure 1 - MVG COMOSAR Validation Dipole

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4 MEASUREMENT METHOD

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

4.1 RETURN LOSS REQUIREMENTS

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

4.2 MECHANICAL REQUIREMENTS

The IEEE Std. 1528 and CEDEC 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:

Expanded Uncertainty on Length
0.05 mm

5.3 VALIDATION MEASUREMENT

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

Scan Volume	Expanded Uncertainty
1 g.	20.3 %

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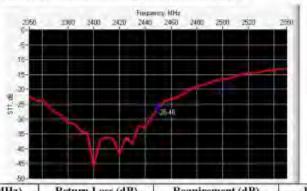




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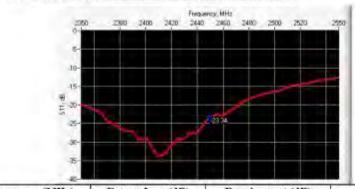
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



| Frequency (MHz) | Return Loss (dB) | Requirement (dB) | Impedance | 2450 | -26.46 | -20 | 49.3 Ω - 4.7 jΩ

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
2450	-23.34	-20	53.4 Ω - 6.2 jΩ

6.3 MECHANICAL DIMENSIONS

Frequency MH2	Le	1 mm		it nim		i mm	
	required	measured	required	measured	required	measured	
300	420.0 ±1 %.		250.0 ±1%		6.35 ±1 %.		

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450	290.0 ±1 %		166.7±1%.		635±1%	
750	176,0±1 %		100,0±1%.		6.35 ±1%	
855	161/0±1 %		89.8 ±1 1/4		3.6±1%	
900	149.0 ±1 %		83.3 :1 %		3.6 :1%	
1450	89.1 ±1 %;		51.7±1%		3.6 21 %.	
1500	80.5±1%		50,0:1%		1.6±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%		41.711%		3.6:21%	
1900	68.0±1%		39.5±1.%		3.6±1/%	
1950	66.3 ±1 %		38.5 ±1.34		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 11.%		3.6 ±1%	
2450	51,5 ±1 %.	PASS	30,441 %	PASS	3.6 ±1%.	PASS
2600	185±1%		28.8 ±1.%		3.6:1%	
3000	41.5 ±1%		25,0 ±1.%		3.6:1%	
3500	37 0±1 H.		26.4±1 %		3.6 ±1.9L	
3700	34.7±1 %.		26.4 ±1%		3.6 11%	

7 VALIDATION MEASUREMENT

The IEEE Std. 1528, FCC KDBs and CEFEC 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 I HEAD LIQUID MEASUREMENT

Frequency MH2	Relative per	mitthvity (s.')	Conductiv	ity (a) 5/m
	regulred	measured	required	measured
300	45.3.15.76		0.8715%	
450	43.5 ±5 %		0.87 ±5 %	
750	41,9 ±5 %		0.89 ±5 %	
835	41.5 ±5%		0.90±5 N	
900	W1,5±5%		0.97 ±5 %	
1450	40.5 ±5 %		1.20 +5 %	
1500	40.4 45 %		1.23 15 %	
1640	40.2±5%		1.31 ±5 %	
1750	40.1 ±5 %		1.37 ±5 %	

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	1.40 ±5 %		40.0±5.%	1800
	1,40 ±5 %		40.0 ±5 %	1900
	1,40 ±5 %		40.0°±5 %	1950
	1.40.15%		40.0±5%	2000
	1,49 ±5%		39.8 ±5.14	2100
	1.67±5%		39.5 ±5 %	2300
PASS	180±5%	PA55	39,2±5 \	2450
	1.96±5%		39.0'±5.14	2600
	2,40 ±5 %		38,5 ±5 %	3000
	2.91.45 %		37.9 45 %	3500

7.2 SAR MEASUREMENT RESULT WITH READ 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 2009 SAM71		
Probe	SN 18/11 EPG122		
Liquid	Head Liquid Values: pps 38.9 sigma 179		
Distance between dipole center and liquid	10.0 mm		
Area scan resolution	ds-Smm dy-Smm		
Zoen Scan Resolution	dx-Smm dy-Sm/dz-Smm		
Frequency:	2450 MHz		
Input power	20 dRm		
Liquid Temperature	21°C		
Lab Temperature	21 °C		
Lab Humidity	35 %		

Frequency	1 g SAR (W/kg/W)		10 g SAB (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	
3450	29		16	
1500	30,5		16.8	
1640	34.2		18.4	
1750	36.4		19.3	
3,800	38,4		20.1	

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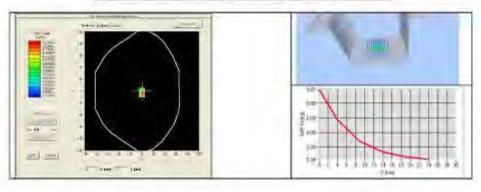
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1900	39.7		20.5	
1950	40.5		20.9	
2000	41.1		21.1	
2100	.43.6		21.9	
2300	48.7		23.3	
2450.	52.4	54.29 (5.43)	24	24.20 (2.42)
2600	55,3		24.6	
3000	63.8		25.7	
3500	67,1		25	



7.3 BODY LIQUID MEASUREMENT

Frequency MHz	Relative per	Relative permittivity (c.')		ity (a) S/m
	required	measured	required	measured
150	61.9 ±5.56	-	0.80 ±5 %	
300	58.2 ±5 %		0.92 ±5 %	
450	56.7 ±5 %		0.94 ±5%	
750	55.5 ±5 %		0.96 ±5 %	
835	55.2 ±5 %		0.97 ±5 %	
900	55.0 ±5 %		1.05 ±5 %	
915	55,0 ±5 %		1.06±5%	
1450	54.0 ±5.58		1.30±5%	-
1610	53.8 ±5 %		1.40 ±5 %	
1800	53.3 ±5 %		1.52 ±5 %	
1900	53.3 15 %		1.52 ±5%	
2000	53.3 ±5.%		1,52 ±5 %	
2100	53.2 ±5 %		1.62 ±5 %	
2450	52.7 ±5 %	PASS	1.95 ±5 %	PASS

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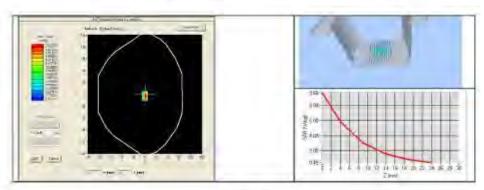
Res: ACR.75.13.15.SA(1) A

2600	52.5 ±5 %	2.16±5%
3000	52.0 ±5 16	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 52.7 sagma: 1.94
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx-5mm/dy-5m/dz-5mm
Frequency	2450 MHz
Input power	20 dBm
Liquid Temperature	21°C
Lab Temperature	21 °C
Lab Hemidity	45 %

Frequency MHz	1 g SAR (W/kg/W)	10 g SAR (W/kg/W)
	measured	measured
2450	54.70 (5.47)	24.86 (2.49)



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8 LIST OF EQUIPMENT

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 ca required	
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated, No ca required.	
Network Analyzer	Rhode & Schwarz ZVA	SN100132	02/2013	02/2016	
Calipers	Garrera	CALIPER-01	12/2013	12/2016	
Reference Probe	MVG	EPG122 SN 18/11	10/2014	10/2015	
Multimeter	Kelthley 2000	1188656	12/2013	12/2016	
Signal Generator	Agilent E4438C	MY49070581	12/2013	12/2016	
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required	Characterized prior to test. No cal required.	
Power Meter	HP E4418A	US38261498	12/2013	12/2016	
Power Sensor	HP ECP-E26A	US37181460	12/2013	12/2016	
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.	
Temperature and Hurnidity Sensor	Control Company	11-661-9	8/2012	8/2015	

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F.7 2600 MHz Dipole



SAR Reference Dipole Calibration Report

Ref: ACR.75.14.15.SATU.A

SHENZHEN BALUN TECHNOLOGY CO.,LTD.

BLOCK B, FL 1, BAISHA SCIENCE AND TECHNOLOGY PARK, SHAHE XI ROAD,

NANSHAN DISTRICT, SHENZHEN, GUANGDONG PROVINCE, P.R. CHINA 518055

MVG COMOSAR REFERENCE DIPOLE

FREQUENCY: 2600 MHZ

SERIAL NO.: SN 25/13 DIP 2G600-254

Calibrated at MVG US

2105 Barrett Park Dr. - Kennesaw, GA 30144





03/16/2015

Summary:

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





ROUNCE TS LA 15 SAIT! A

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	3/16/2015	15
Checked by z	Jerôme LUC	Product Manager	3/16/2015	JS
Approved by:	Kim RUTKOWSKI	Quality Manager	3/16/2015	Ann Vorteral

	Customer Name
MCCON NO.	SHENZHEN
	BALUN
Distribution :	TECHNOLOGY
	Co.,Ltd.

Issue	Date	Modifications
A	3/16/2015	Initial release
		The second secon

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ROS ACR. 75.14 15 SATULA.

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 2600 MHz REFERENCE DIPOLE	
Manufacturer	MVG	
Model	SID2600	
Serial Number	SN 25/13 DIP 2G600-254	
Product Condition (new / used)	Used	

A yearly calibration interval is recommended.

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

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



Figure 1 - MVG COMOSAR Validation Dipole

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4 MEASUREMENT METHOD

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

4.1 RETURN LOSS REQUIREMENTS

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

4.2 MECHANICAL REQUIREMENTS

The IEEE Std. 1528 and CEUEC 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

Expanded Uncertainty on Return Loss
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 CELIEC 62209 standards were followed to generate the measurement uncertainty for validation measurements.

Scan Volume	Expanded Uncertainty
1 g.	20.3 %

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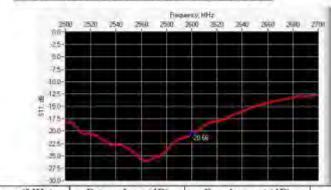


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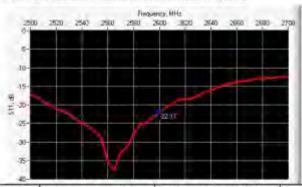
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



| Frequency (MHz) | Return Loss (dB) | Requirement (dB) | Impedance | 2600 | -20.66 | -20 | 51.0 Ω + 9.4 jΩ

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
2600	-22.17	-20	$47.9 \Omega + 7.5 j\Omega$

6.3 MECHANICAL DIMENSIONS

Frequency MH2	Le	I mm		ir mm		nm
	required	measured	required	measured	required	measured
300	420.0 ±1 %.		250.0 ±1%:		6.35 ±1 %.	

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450	290.0 ±1 %		166.7±1%.		635±1%	
750	176,0±1 %		100,0±1%.		6.35 ±1%	
855	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 21 %.	
1500	80.5±1%		50,0±1%		1.6±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%		41.711%		3.6 21%	
1900	68.0±1%		39.5±1.%	1	3.6±1/%	
1950	66.3 ±1.W.		38.5 ±1.34		3.6±154	
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 11.%		3.6 ±1%	
2450	51,5 ±1 %.		30,441 %		3.6 ±1%.	
2600	185±1%	PASS	28.8 ±1%	PA55	3.6:1%	PAS
3000	41.5±1%		25,0 ±1.%		3.6:1%	
3500	37 0±1 H.		26.4±1 %		3.6±1.9L	
3700	34.7±1 %.		26.4 11 %		3.6 91%	

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.

71 HEAD LIQUID MEASUREMENT

Frequency	Relative permitt/vity (s.')		Conductivity (a) 5/n	
	regulred	measured	required	measured
300	45.3.15/6		0.8715%	
450	43.5 ±5 %		0.87±5%	
750	41.9 ±5 %		0.89 ±5 %	
835	41.5 ±5%		0.50±5 N	
900	W1,5±5%		0.97 ±5 %	
1450	40.5 ±5 %		1.20 ±5 %	
1500	40.4 15 16		1.23 15 %	
1640	40.2±5%		1.31 ±5 %	
1750	40.1 ±5 %		1.37 ±5 %	

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	1.40 ±5 %		40.0 ±5.%	1800
	1,40 ±5 %		40,0 45 %	1900
	1,40 ±5 %		40,015%	1950
	1.40.15%		40.0 ±5 %	2000
	1.49 ±5%		39.8 ±5.1%	2100
	1.67 ±5 %		39.5±5 W	2300
	180±5%		39,2±5\/	2450
PASS	1.96 ±5 %	PASS	39.0/±5.W	2600
	2,40 ±5 %		38.5 ±5 %	3000
	2.95.±5 W		37.9 45 %	3500

7.2 SAR MEASUREMENT RESULT WITH READ 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 2009 SAM71	
Prohe	SN 18/11 EPG122	
Laquid	Head Liquid Values: eps 38.2 sigma 193	
Distance between dipole center and liquid	10.0 mm	
Area scan resolution	dx-Smm/dy-Smm	
Zoon Scan Resolution	dx-Smm/dy=5mm/dz-5mm	
Frequency	2600 MHz	
Input power	20 dFm	
Liquid Temperature	21 °C	
Lab Temperature	10°C	
Lab Hiemidity	35 to	

Frequency	1 g SAR (1 g 5AR (W/kg/W)		(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	
3.800	38,4		20.1	

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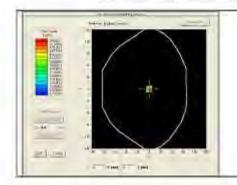
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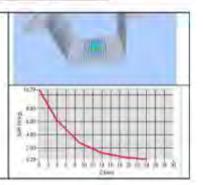




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1900	39.7		20.5	
3950	40.5		20.9	
2000	41.1		21.1	
2100	.43.6		21.9	
2300	48.7		23.3	
2450	52.4		24	
2600	55,3	57.37 (5.74)	24.6	24 68 (2.47)
3000	63.8		25.7	
3500	67,1		25	





7.3 BODY LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (c.)		Conductiv	ity (a) S/m
=	required	measured	required	measured
150	61.9 ±5.56		0.80 ±5 %	
300	58.2 ±5 %		0.92 ±5%	
450	56.7 ±5 %		0.94 ±5 %	
750	55.5 ±5 %		0.96 ±5 %	
835	55.2 ±5 %		0.97 ±5 %	
900	55.0 ±5 %		1.05 ±5 %	
915	55.0 ±5 %		1.06±5%	
1450	54.0 ±5 %		1.30±5%	-
1610	53.8 ±5 %		1.40 ±5 %	
1800	53.3 ±5 %		1.52 ±5 %	
1900	53.3 ±5 %		1.52 ±5 %	
2000	53.3 ±5.%		1,52 ±5 %	
2100	53.2 ±5 %		1.62 ±5 %	
2450	52.7 ±5 %		1.95 ±5 %	

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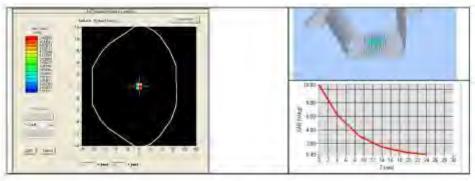
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2600	52.5 ±5 %	PASS	2.16±5%	PASS
3000	52.0 ±5 %		2,73 ±5 %	
3500	51,3 ±5 %		3.31 25 %	
5200	49.0 ± 10 %		5.30±10%	
5300	48.9 ±10%		5.42 ±10 %	
5400	48.7 ±10 %		5.53±10%	
5500	48.6 ±10 %		5,65 ±10 %	
5600	48.5 ±10.%		5.77±10%	
5800	48.2±10 %		6,00±10%	

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 51.6 sagma. 2.21
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx 5mm/dy 5mm/dz 5mm
Frequency	2600 MHz
Input power	20 dBm
Liquid Temperature	21°C
Lab Temperature	21 °C
Lab Humidity	43 %

Frequency MHz	1 g SAR (W/kg/W)	10 g SAR (W/kg/W)
	measured	measured
2600	57.62 (5.76)	25.39 (2.54)



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8 LIST OF EQUIPMENT

	Equi	pment Summary S	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 ca required
COMOSAR Test Bench	Version 3	NA	Validated. No call required.	Validated No ca required
Network Analyzer	Rhode & Schwarz ZVA	SN100132	02/2013	02/2016
Calipers	Carrera	CALIPER-01	12/2013	12/2016
Reference Probe	MVG	EPG122.SN 18/11	10/2014	10/2015
Mutimeter	Keithley 2000	1188656	12/2013	12/2016
Signal Generator	Agilent E4438C	MY49070531	12/2013	12/2016
Amplifier	Aetheroomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4416A	US38261498	12/2013	12/2016
Power Sensor	HP ECP-E26A	US37181460	12/2013	12/2016
Directional Coupler	Nardá 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required
Temperature and Humidity Sensor	Control Company	11-661-9	8/2012	B/2015

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F.8 Waveguide



SAR Reference Waveguide Calibration Report

Ref. ACR.75.15.15.SATU.A

SHENZHEN BALUN TECHNOLOGY CO.,LTD.

BLOCK B, FL 1, BAISHA SCIENCE AND TECHNOLOGY PARK, SHAHE XI ROAD,

NANSHAN DISTRICT, SHENZHEN, GUANGDONG PROVINCE, P.R. CHINA 518055

MVG COMOSAR REFERENCE WAVEGUIDE

FREQUENCY: 5000-6000 MHZ SERIAL NO.: SN 30/13 WGA24

Calibrated at MVG US

2105 Barrett Park Dr. - Kennesaw, GA 30144





03/16/2015

Summary:

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





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	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	3/16/20(5	15
Checked by ;	Jérôme LUC	Product Manager	3/16/2015	J85
approved by ;	Kim RUTKOWSKI	Quality Manager	3/16/2015	10 to facilities

	Customer Name
Enstraination (SHENZHEN BALUN TECHNOLOGY

Issue	Date	Modifications
A	3/16/2015	Initial release
- Y'-		

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1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEEE 1528 and CEI/IEC 62209 standards for reference waveguides 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 5000-6000 MHz REFERENCE WAVEGUIDE
Manufacturer	MVG
Model	SWG5500
Serial Number	SN 30/13 WGA24
Product Condition (new / used)	Used

A yearly calibration interval is recommended.

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

MVG's COMOSAR Validation Waveguides are built in accordance to the IEEE 1528 and CEI/IEC 62209 standards.

4 MEASUREMENT METHOD

The IEEE 1528 and CEI/IEC 62209 standards provide requirements for reference waveguides 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 waveguide used for SAR system validation measurements and checks must have a return loss of +8 dB or better. The return loss measurement shall be performed with matching layer placed in the open end of the waveguide, with the waveguide and matching layer in direct contact with the phantom shell as outlined in the fore mentioned standards.

4.2 MECHANICAL REQUIREMENTS

The IEEE 1528 and CEI/IEC 62209 standards specify the mechanical dimensions of the validation waveguide, the specified dimensions are as shown in Section 6.2. Figure 1 shows how the dimensions relate to the physical construction of the waveguide.

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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:

Expanded Uncertainty on Return Loss
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

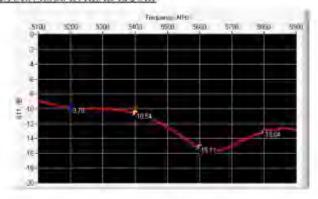
5.3 VALIDATION MEASUREMENT

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

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

6. CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS IN HEAD LIQUID



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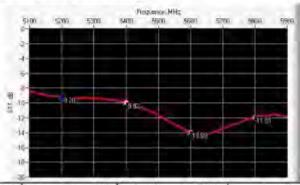




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Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
5200	-9.78	-8	26.6 Ω = 9.1 jΩ
5400	-10:54	-8	$89.7 \Omega + 12.3 j\Omega$
5600	-15,11	-8	38.1 Ω - 9.8 jΩ
5800	-13.04	-8	$54.0 \Omega = 23.4 j\Omega$

6.2 RETURN LOSS IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
5200	-9.20	-8	$25.7 \Omega + 10.6 j\Omega$
5400	-9.92	-8	95.8 Ω + 8.8 jΩ
5600	-13.89	-8	35.3 Ω - 9.2 jΩ
5800	-11.91	-8	56.0 Ω = 27.2 jΩ

6.3 MECHANICAL DIMENSIONS

to see see s	L (num)		W (mem).	Lat	mana)	Wes	mann)	To	untin)
y (MHz)	Require	Missisme I	Require	Measure d	Require	Measure A	Require	Measani d	Require	Measure
5200	40.39 = -0.13	PASS	20.19 ±	PASS.	81.03± 0.13	PASS	61.98± 0.13	PASS	5.3*	PASS
5800	40.39 ± 0.13	PASS	20.19 ± 0.13	PASS	81.03 ± 0.43	PASS	61.88 ± 0.13	FASS	43*	PASS

^{*} The tolerance for the matching layer is included in the return loss measurement.

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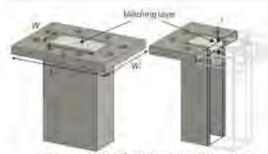


Figure 1: Validation Waveguide Dimensions

VALIDATION MEASUREMENT

The IEEE Std. 1528 and CEI/IEC 62209 standards state that the system validation measurements must be performed using a reference waveguide meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed with the matching layer placed in the open end of the waveguide, with the waveguide and matching layer in direct contact with the phantom shell.

7.1 HEAD LIQUID MEASUREMENT

Frequency	Relative per	mittivity (s.')	Conductivity (a) 5/m	
	regulred	measured	required	measured
5000	36.2 ±10 %		4,45 ±10%	_
5100	36.1±10%		4.56 ±10 %	
5200	36.0 ±10 %	PASS	4.66 ±10 %	PASS
5300	35.9±10%		A,76±10%	
5400	35.8 ±10%	PASS	4.86 ±10 %	PASS
5300	35.6 ±10 %		4.97±10%	
5600	35.5 ±10 %	PASS	5.07 ±10 %	PASS
5700	35.4 ±10 %		5.17 ±10 %	
5800	35.3±10%	PASS	5.27 ±10 %	PASS
5900	35.2410%		5.38±10%	
6000	35.1±10%		5.48 ±10 %	

7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

At those frequencies, the target SAR value can not be generic. Hereunder is the target SAR value defined by MVG, within the uncertainty for the system validation. All SAR values are normalized to 1 W net power. In bracket, the measured SAR is given with the used input power.

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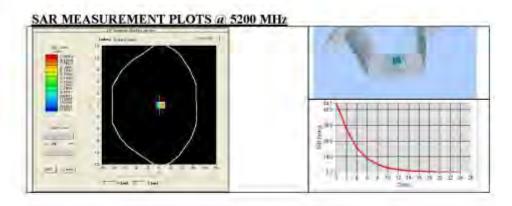




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Software	OPENSAR V4	
Phantom	SN 20/09 SAM71	
Probe	SN 18/11 EPG122	
Liquid	Head Liquid Values 5200 MHz eps' 36.44 sigma 4.79 Head Liquid Values 5400 MHz eps' 35.99 sigma 4.91 Head Liquid Values 5600 MHz eps' 35.22 sigma 5.18 Head Liquid Values 5800 MHz eps' 34.95 sigma 5.42	
Distance between dipole waveguide and liquid	O mm	
Area scan resolution	dx=8mm/dy=8mm	
Zoon Scan Resolution	dx-4mm/dy-4m/dz-2mm	
Frequency	5200 MHz 5400 MHz 5600 MHz 5800 MHz	
Input power	20 dBm	
Liquid Temperature	31 °C	
Lab Temperature	21 'C'	
Lab Humidity	45 %	

Frequency (MHz)	I g SAR (W/kg)		10 g SAR (W/kg)	
	required	measured	required	measured
5200	159.00	157.80 (15.78)	56.90	55.01 (5.50)
5400	166.40	162.69 (16.27)	58.43	56.17 (5.62)
5600	173.80	171,22 (17.12)	59.97	58.57 (5.86)
5800	181.20	179.53 (17.95)	61.50	60.55 (6.05)



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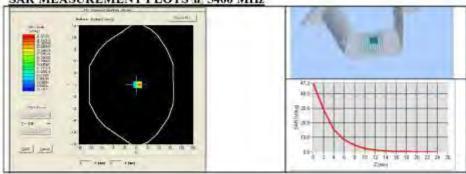
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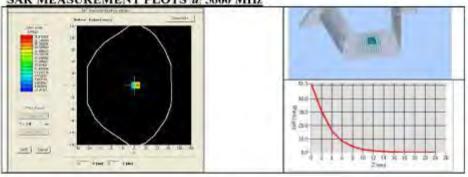


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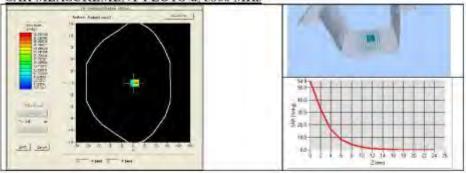
SAR MEASUREMENT PLOTS @ 5400 MHz



SAR MEASUREMENT PLOTS @ 5600 MHz



SAR MEASUREMENT PLOTS @ 5800 MHz



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7.3 BODY LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (c.')		Conductivity (a) S/m	
	inquired	measured	required	measured
5200	49.0 ±10.90	PASS	5.30±20%	PASS
5300	48.9±10W		5.42 ±50 %	
5400	48.7 ±10%	PASS	5.53.610%	PASS
5500	48.5 ±10 %		5.65 \$10 %	
5600	48.5 ±10 %	PASS	5.77±10%	PASS
5800	48.2±10%	PASS .	6.00±10%	PASS

7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

Software	OPENSAR V4
Phantom	SN 2019 SAM71
Probe	SN 18/11 EPG172
Liquid	Body Liquid Values 5200 MHz: eps: 50.70 sigms: 5.11 Doa'v Liquid Values 5400 MHz: eps: 50.01 sigms: 5.64 flody Liquid Values 5600 MHz: eps: 49.34 sigms: 5.85 Body Liquid Values 5800 MHz: eps: 48.54 sigms: 6.22
Distance between dipole waveguide and liquid	Cunm
Area scan resolution	de Britin dy Britin
Zoon Scan Resolution	ds: 4mm dy -4m/dz -2mm
Frequency	5200 MHz 5400 MHz 5600 MHz 5800 MHz
Input power	20 dBm
Liquid Temperature	\$1.5°
Lab l'emperature	31.5C
Lab Humidity	45%

Frequency (MHz)	1 g SAR (Wkg)	10 g SAR (W/kg)
	measured	measured
5200	155,12 (15.51)	54,66 (5,47)
5400	162.06 (16.21)	56.46 (5.65)
5600	167.13 (16.71)	37.78 (5.78)
5800	173.19 (17.32)	59,30 (5.93)

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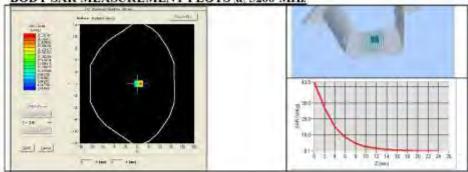
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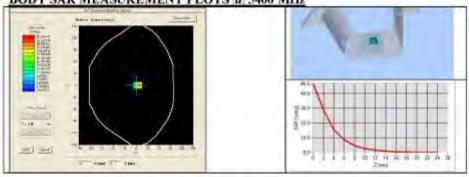


Ref: ACR.75.15.14.SATU.A.

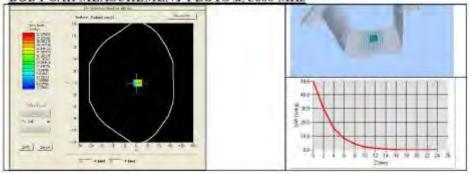
BODY SAR MEASUREMENT PLOTS @ 5200 MHz



BODY SAR MEASUREMENT PLOTS @ 5400 MHz



BODY SAR MEASUREMENT PLOTS @ 5600 MHz



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Rate ACR-75 15 14 SATELA

8 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 ca required			
COMOSAR Test Bench	Version 3	NA	Validated. No call required.	Validated No ca required			
Network Analyzer	Rhode & Scrwarz ZVA	SN100132	02/2013	02/2016			
Calipers	Carrera	CALIPER-01	12/2013	12/2016			
Reference Probe	MVG	EPG122.SN 18/11	10/2014	10/2015			
Multimeter	Keithley 2000	1188656	12/2013	12/2016			
Signal Generator	Agilent E4438C	MY49070531	12/2013	12/2016			
Amplifier	Aetheroomm	SN 046	Characterized prior to test. No cal required,	Characterized prior to test. No cal required.			
Power Meter	HP E4416A	US38261498	12/2013	12/2016			
Power Sensor	HP ECP-E26A	US37181460	12/2013	12/2016			
Directional Couple:	Nardá 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required			
Temperature and Humidity Sensor	Control Company	11,661-9	8/2012	8/2015			

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ROS ACR. 75 15 14 SAITE A.

8 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 ca required			
COMOSAR Test Bench	Version 3	NA	Validated. No call required.	Validated No ca required			
Network Analyzer	Rhode & Scrwarz ZVA	SN100132	02/2013	02/2016			
Calipers	Carrera	CALIPER-01	12/2013	12/2016			
Reference Probe	MVG	EPG122.SN 18/11	10/2014	10/2015			
Multimeter	Keithley 2000	1188656	12/2013	12/2016			
Signal Generator	Agilent E4438C	MY49070531	12/2013	12/2016			
Amplifier	Aetheroomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required			
Power Meter	HP E4416A	US38261498	12/2013	12/2016			
Power Sensor	HP ECP-E26A	US37181460	12/2013	12/2016			
Directional Coupler	Nardá 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required			
Temperature and Humidity Sensor	Control Company	11-661-9	8/2012	B/2015			

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F.9 SATIMO Dipole

Please refer the document "SATIMO Dipole Measurement Report.pdf".

--END OF REPORT--