

Ref: ACR.287.8.14.SATU.A

#### 7.3 BODY LIQUID MEASUREMENT

Frequency MHz	Relative per	mittivity $\{\epsilon_r'\}$	Conductiv	ity (σ) 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 %		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 %	PASS	1.95 ±5 %	PASS
2600	52.5 ±5 %		2.16 ±5 %	
3000	52.0 ±5 %		2.73 ±5 %	
3500	51.3 ±5 %		3.31 ±5 %	
5200	49.0 ±10 %		5.30 ±10 %	
5300	48.9 ±10 %		5.42 ±10 %	
5400	48.7 ±10 %		5.53 ±10 %	
5500	48.6 ±10 %		5.65 ±10 %	
5600	48.5 ±10 %		5.77 ±10 %	
5800	48.2 ±10 %	-	6.00 ±10 %	

#### 7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

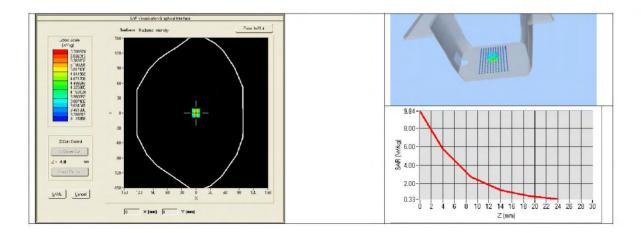
Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Body Liquid Values: eps': 53.0 sigma: 1.93
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=8mm/dy=8m/dz=5mm
Frequency	2450 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

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Frequency MHz	1 g SAR (W/kg/W)	10 g SAR (W/kg/W)
	measured	measured
2450	54.65 (5.46)	24.58 (2.46)



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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	Satimo	SN-20/09-SAM71	Validated. No cal required.	Validated. No cal required.	
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.	
Network Analyzer	Rhode & Schwarz ZVA	SN100132	02/2016	02/2019	
Calipers	Carrera	CALIPER-01	12/2016	12/2019	
Reference Probe	Satimo	EPG122 SN 18/11	10/2018	10/2019	
Multimeter	Keithley 2000	1188656	12/2016	12/2019	
Signal Generator	Agilent E4438C	MY49070581	12/2016	12/2019	
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.	
Power Meter	HP E4418A	US38261498	12/2016	12/2019	
Power Sensor	HP ECP-E26A	US37181460	12/2016	12/2019	
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	8/2016	8/2019	

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#### 5.7 SID2600 Dipole Calibration Ceriticate



# **SAR Reference Dipole Calibration Report**

Ref: ACR.273.4.18.SATU.A

# SHENZHEN LCS COMPLIANCE TESTING LABORATORY LTD.

1F., XINGYUAN INDUSTRIAL PARK, TONGDA ROAD, BAO'AN BLVD BAO'AN DISTRICT, SHENZHEN, GUANGDONG, CHINA

MVG COMOSAR REFERENCE DIPOLE

FREQUENCY: 2600 MHZ

SERIAL NO.: SN 38/18 DIP 2G600-468

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





Calibration Date: 09/24/2018

#### Summary:

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



Ref: ACR.273.4.18.SATU.A

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	09/30/2018	JES
Checked by:	Jérôme LUC	Product Manager	09/30/2018	Jes
Approved by :	Kim RUTKOWSKI	Quality Manager	09/30/2018	them Prethowski

	Customer Name
	Shenzhen LCS
Distribution:	Compliance Testing
	Laboratory Ltd.

Issue	Date	Modifications
A	09/30/2018	Initial release

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Internalization

#### SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.273.4.18.SATU.A

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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

De	evice Under Test
Device Type	COMOSAR 2600 MHz REFERENCE DIPOLE
Manufacturer	MVG
Model	SID2600
Serial Number	SN 38/18 DIP 2G600-468
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 flat phantom, with the phantom constructed as outlined in the fore mentioned standards.

#### 4.2 MECHANICAL REQUIREMENTS

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

#### 5 MEASUREMENT UNCERTAINTY

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

#### 5.1 RETURN LOSS

The following uncertainties apply to the return loss measurement:

Frequency band	<b>Expanded Uncertainty on Return Loss</b>
400-6000MHz	0.1 dB

#### 5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

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

#### 5.3 VALIDATION MEASUREMENT

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

Scan Volume	Expanded Uncertainty
1 g	20.3 %

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#### 4 MEASUREMENT METHOD

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Scan Volume	Expanded Uncertainty
1 g	20.3 %

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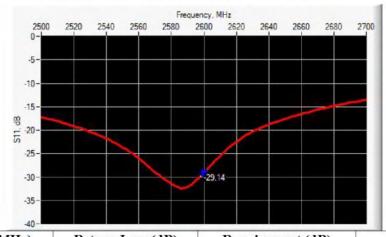


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10 g	20.1 %	

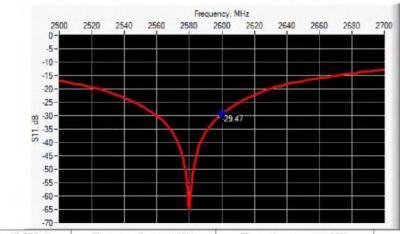
#### 6 CALIBRATION MEASUREMENT RESULTS

#### 6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)Return Loss (dB)Requirement (dB)Impedance2600-29.14-20 $49.2 \Omega + 3.4 j\Omega$ 

#### 6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
2600	-29.47	-20	$47.5 \Omega + 2.2 i\Omega$

#### 6.3 MECHANICAL DIMENSIONS

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

#### 7 VALIDATION MEASUREMENT

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

#### 7.1 HEAD LIQUID MEASUREMENT

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

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.800	40.0 ±5 %		1.40 ±5 %	
.900	40.0 ±5 %		1.40 ±5 %	
.950	40.0 ±5 %		1.40 ±5 %	
000	40.0 ±5 %		1.40 ±5 %	
100	39.8 ±5 %		1.49 ±5 %	
300	39.5 ±5 %		1.67 ±5 %	
450	39.2 ±5 %		1.80 ±5 %	
600	39.0 ±5 %	PASS	1.96 ±5 %	PASS
000	38.5 ±5 %		2.40 ±5 %	
500	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': 39.8 sigma: 1.99	
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	45 %	

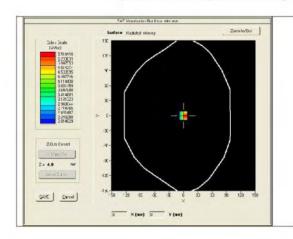
Frequency MHz	1 g SAR (W/kg/W)		10 g SAR (W/kg/W)	
	required	measured	required	measured
300	2.85		1.94	
450	4.58		3.06	
750	8.49		5.55	
835	9.56		6.22	
900	10.9		6.99	
1450	29		16	
1500	30.5		16.8	
1640	34.2		18.4	
1750	36.4		19.3	
1800	38.4		20.1	

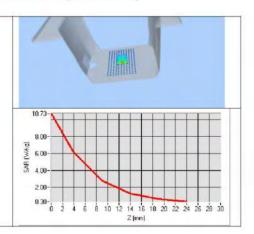
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1900	39.7		20.5	
1950	40.5		20.9	
2000	41.1		21.1	
2100	43.6		21.9	
2300	48.7		23.3	
2450	52.4		24	
2600	55.3	56.91 (5.69)	24.6	24.69 (2.47)
3000	63.8		25.7	
3500	67.1		25	
3700	67.4		24.2	





#### 7.3 BODY LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ε <sub>r</sub> ')		Conductivity ( $\sigma$ ) 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 %		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 %	

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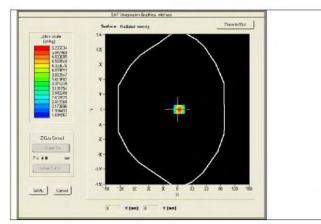
Ref: ACR.273.4.18.SATU.A

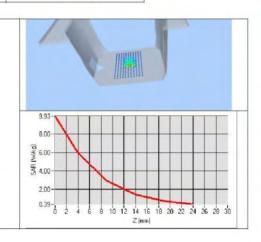
2300	52.9 ±5 %		1.81 ±5 %	
2450	52.7 ±5 %		1.95 ±5 %	
2600	52.5 ±5 %	PASS	2.16 ±5 %	PASS
3000	52.0 ±5 %		2.73 ±5 %	
3500	51.3 ±5 %		3.31 ±5 %	
3700	51.0 ±5 %		3.55 ±5 %	
5200	49.0 ±10 %		5.30 ±10 %	
5300	48.9 ±10 %		5.42 ±10 %	
5400	48.7 ±10 %		5.53 ±10 %	
5500	48.6 ±10 %		5.65 ±10 %	
5600	48.5 ±10 %		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': 52.5 sigma: 2.23		
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	45 %		

Frequency MHz	1 g SAR (W/kg/W)	10 g SAR (W/kg/W)	
	measured	measured	
2600	54.14 (5.41)	24.13 (2.41)	





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#### 8 LIST OF EQUIPMENT

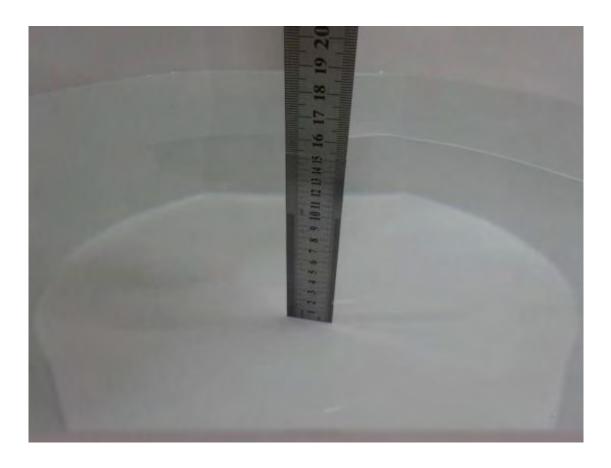
Equipment Description SAM Phantom	Manufacturer / Model MVG	SN-20/09-SAM / 1		Next Calibration Date		
				Validated. No ca required.		
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No ca required.		
Network Analyzer	Rhode & Schwarz ZVA	SN100132	02/2016	02/2019		
Calipers	Carrera	CALIPER-01	01/2017	01/2020		
Reference Probe	MVG	EPG122 SN 18/11	10/2017	10/2018		
Multimeter	Keithley 2000	1188656	01/2017	01/2020		
Signal Generator	Agilent E4438C	MY49070581	01/2017	01/2020		
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.		
Power Meter	HP E4418A	US38261498	01/2017	01/2020		
Power Sensor	HP ECP-E26A	US37181460	01/2017	01/2020		
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.			
Temperature and Humidity Sensor	Control Company	150798832	11/2017	11/2020		

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# **6.SAR System PHOTOGRAPHS**

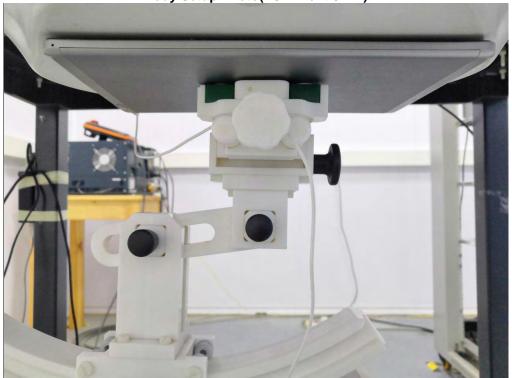


Liquid depth ≥ 15cm

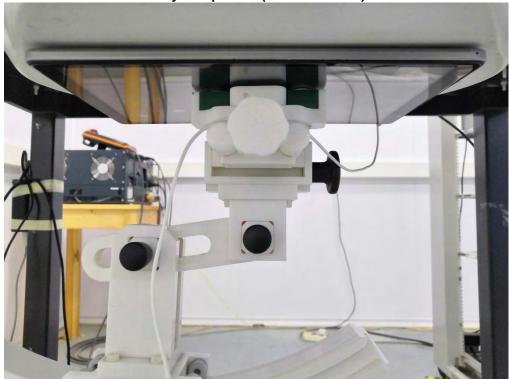


### 7.SETUP PHOTOGRAPHS





**Body Setup Photo(LCD Rear 0mm)** 



Body Setup Photo(LCD Left 0mm)







Body Setup Photo(LCD Top 0mm)







# **8.EUT Photographs**



Fig.1

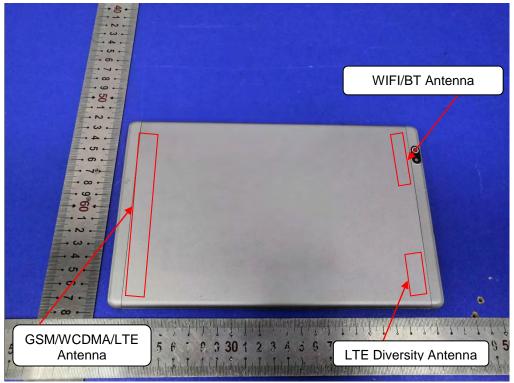


Fig.2

.....The End of Test Report.....