CALIBRATION REPORT

F.1 E-Field Probe

COMOSAR E-Field Probe Calibration Report

Ref : ACR.93.1.17.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 DOSIMETRIC E-FIELD PROBE
SERIAL NO.: SN 08/16 EPGO295

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

ACCREDITED
Calibration CERT #2246-02

Calibration Date: 03/22/2017

Summary:

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

COMOSAR E-FIELD PROBE CALIBRATION REPORT Ref: ACR.93.1.17.SATU.A

	Name	*Function*	*Date*	*Signature*
Prepared by :	Jérôme LUC	Product Manager	4/3/2017	
Checked by :	Jérôme LUC	Product Manager	4/3/2017	
Approved by :	Kim RUTKOWSKI	Quality Manager	4/3/2017	

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

Issue	*Date*	*Modifications*
A	4/3/2017	Initial release

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1 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR DOSIMETRIC E FIELD PROBE
Manufacturer	MVG
Model	SSE2
Serial Number	SN 08/16 EPGO295
Product Condition (new / used)	New
Frequency Range of Probe	0.3 GHz-6GHz
Resistance of Three Dipoles at Connector	Dipole 1: R1=0.212 MΩ Dipole 2: R2=0.190 MΩ Dipole 3: R3=0.189 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.

3.2 SENSITIVITY

The sensitivity factors of the three dipoles were determined using a two step calibration method (air and tissue simulating liquid) using waveguides as outlined in the standards.

3.3 LOWER DETECTION LIMIT

The lower detection limit was assessed using the same measurement set up as used for the linearity measurement. The required lower detection limit is 10 mW/kg.

3.4 ISOTROPY

The axial isotropy was evaluated by exposing the probe to a reference wave from a standard dipole with the dipole mounted under the flat phantom in the test configuration suggested for system validations and checks. The probe was rotated along its main axis from 0 - 360 degrees in 15 degree steps. The hemispherical isotropy is determined by inserting the probe in a thin plastic box filled with tissue-equivalent liquid, with the plastic box illuminated with the fields from a half wave dipole. The dipole is rotated about its axis (0°–180°) in 15° increments. At each step the probe is rotated about its axis (0°–360°).

3.5 BOUNDARY EFFECT

The boundary effect is defined as the deviation between the SAR measured data and the expected exponential decay in the liquid when the probe is oriented normal to the interface. To evaluate this effect, the liquid filled flat phantom is exposed to fields from either a reference dipole or waveguide. With the probe normal to the phantom surface, the peak spatial average SAR is measured and compared to the analytical value at the surface.

4 MEASUREMENT UNCERTAINTY

The guidelines outlined in the IEEE 1528, OET 65 Bulletin C, CENELEC EN50361 and CEI/IEC 62209 standards were followed to generate the measurement uncertainty associated with an E-field probe calibration using the waveguide technique. All uncertainties listed below represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2, traceable to the Internationally Accepted Guides to Measurement Uncertainty.

Uncertainty analysis of the probe calibration in waveguide					
ERROR SOURCES	**Uncertainty value (%)**	**Probability Distribution**	**Divisor**	**ci**	**Standard Uncertainty (%)**
Incident or forward power	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Reflected power	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Liquid conductivity	5.00%	Rectangular	$\sqrt{3}$	1	2.887%
Liquid permittivity	4.00%	Rectangular	$\sqrt{3}$	1	2.309%
Field homogeneity	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Field probe positioning	5.00%	Rectangular	$\sqrt{3}$	1	2.887%

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

5 CALIBRATION MEASUREMENT RESULTS

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

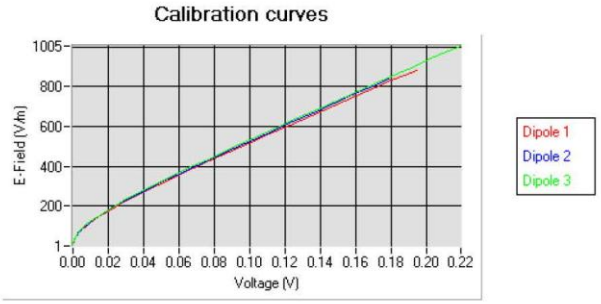
5.1 SENSITIVITY IN AIR

Normx dipole 1 (μV/(V/m)²)	Normy dipole 2 (μV/(V/m)²)	Normz dipole 3 (μV/(V/m)²)
0.78	0.69	0.96

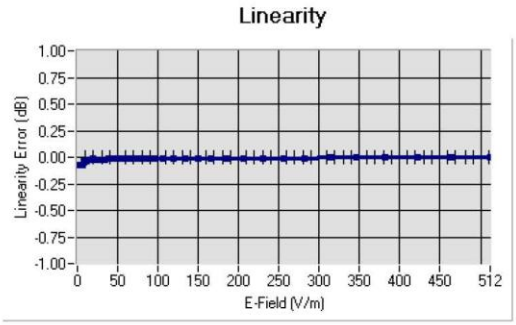
DCP dipole 1 (mV)	DCP dipole 2 (mV)	DCP dipole 3 (mV)
95	90	91

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

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



5.2 LINEARITY



Linearity:±1.68% (+/-0.07dB)

5.3 SENSITIVITY IN LIQUID

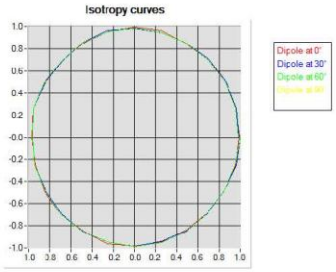
Liquid	Frequency (MHz +/- 100MHz)	Permittivity	Epsilon (S/m)	ConvF
HL450	450	42.17	0.86	1.73
BL450	450	57.65	0.95	1.81
HL750	750	40.03	0.93	1.52
BL750	750	56.83	1.00	1.56
HL850	835	42.19	0.90	1.78
BL850	835	54.67	1.01	1.85
HL900	900	42.08	1.01	1.62
BL900	900	55.25	1.08	1.68
HL1800	1800	41.68	1.46	1.88
BL1800	1800	53.86	1.46	1.94
HL1900	1900	38.45	1.45	2.19
BL1900	1900	53.32	1.56	2.24
HL2000	2000	38.26	1.38	1.97
BL2000	2000	52.70	1.51	2.03
HL2450	2450	37.50	1.80	2.21
BL2450	2450	53.22	1.89	2.30
HL2600	2600	39.80	1.99	2.20
BL2600	2600	52.52	2.23	2.27
HL5200	5200	35.64	4.67	1.32
BL5200	5200	48.64	5.51	1.36
HL5400	5400	36.44	4.87	1.88
BL5400	5400	46.52	5.77	1.92
HL5600	5600	36.66	5.17	1.94
BL5600	5600	46.79	5.77	2.00
HL5800	5800	35.31	5.31	1.76
BL5800	5800	47.04	6.10	1.82

LOWER DETECTION LIMIT: 9mW/kg

5.4 ISOTROPY

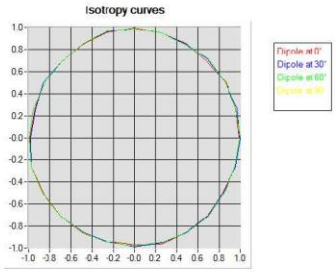
HL900 MHz

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



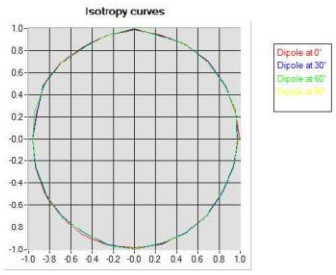
HL1800 MHz

- Axial isotropy: 0.04 dB
- Hemispherical isotropy: 0.08 dB



HL5600 MHz

- Axial isotropy: 0.06 dB
- Hemispherical isotropy: 0.11 dB



6 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	**Manufacturer / Model**	**Identification No.**	**Current Calibration Date**	**Next Calibration Date**
Flat Phantom	MVG	SN-20/09-SAM71	Validated. No cal required.	Validated. No cal required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rhode & Schwarz ZVA	SN100132	02/2016	02/2019
Reference Probe	MVG	EP 94 SN 37/08	10/2016	10/2017
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.	Characterized prior to test. No cal required.
Waveguide	Mega Industries	069Y7-158-13-712	Validated. No cal required.	Validated. No cal required.
Waveguide Transition	Mega Industries	069Y7-158-13-701	Validated. No cal required.	Validated. No cal required.
Waveguide Termination	Mega Industries	069Y7-158-13-701	Validated. No cal required.	Validated. No cal required.
Temperature / Humidity Sensor	Control Company	150798832	10/2015	10/2017

F.2 2450 MHz 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 dipole calibration performed in MVG USA using the COMOSAR test bench. All calibration results are traceable to national metrology institutions.

SAR REFERENCE DIPOLE CALIBRATION REPORT Ref: ACR.75.13.15.SATU.A

	Name	*Function*	*Date*	*Signature*
Prepared by :	Jérôme LUC	Product Manager	3/16/2015	
Checked by :	Jérôme LUC	Product Manager	3/16/2015	
Approved by :	Kim RUTKOWSKI	Quality Manager	3/16/2015	

	Customer Name
Distribution :	SHENZHEN 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

Device 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*

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 constucted as outlined in the fore mentioned standards.

4.2 MECHANICAL REQUIREMENTS

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

5 MEASUREMENT UNCERTAINTY

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

5.1 RETURN LOSS

The following uncertainties apply to the return loss measurement:

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

5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

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

5.3 VALIDATION MEASUREMENT

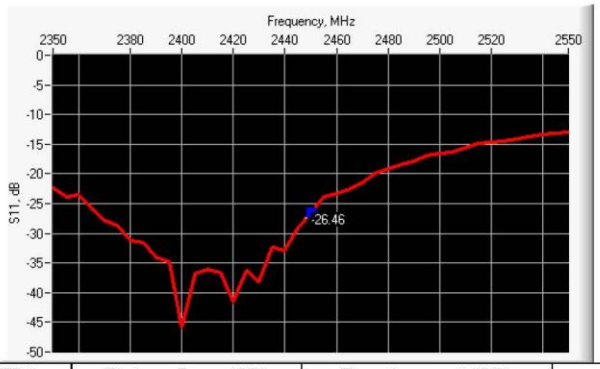
The guidelines outlined in the IEEE 1528, FCC KDBs, CENELEC EN50361 and CEI/IEC 62209 standards were followed to generate the measurement uncertainty for validation measurements.

Scan Volume	Expanded Uncertainty
1 g	20.3 %

10 g	20.1 %

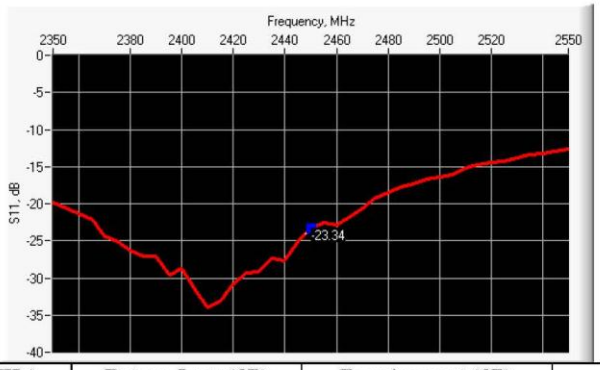
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
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 MHz	L mm		h mm		d mm	
	required	measured	required	measured	required	measured
300	420.0 ±1 %.		250.0 ±1 %.		6.35 ±1 %.	

450	290.0 ±1 %.		166.7 ±1 %.		6.35 ±1 %.	
750	176.0 ±1 %.		100.0 ±1 %.		6.35 ±1 %.	
835	161.0 ±1 %.		89.8 ±1 %.		3.6 ±1 %.	
900	149.0 ±1 %.		83.3 ±1 %.		3.6 ±1 %.	
1450	89.1 ±1 %.		51.7 ±1 %.		3.6 ±1 %.	
1500	80.5 ±1 %.		50.0 ±1 %.		3.6 ±1 %.	
1640	79.0 ±1 %.		45.7 ±1 %.		3.6 ±1 %.	
1750	75.2 ±1 %.		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 %.	PASS	30.4 ±1 %.	PASS	3.6 ±1 %.	PASS
2600	48.5 ±1 %.		28.8 ±1 %.		3.6 ±1 %.	
3000	41.5 ±1 %.		25.0 ±1 %.		3.6 ±1 %.	
3500	37.0±1 %.		26.4 ±1 %.		3.6 ±1 %.	
3700	34.7±1 %.		26.4 ±1 %.		3.6 ±1 %.	

7 VALIDATION MEASUREMENT

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

7.1 HEAD LIQUID MEASUREMENT

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

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 %	PASS	1.80 ±5 %	PASS
2600	39.0 ±5 %		1.96 ±5 %	
3000	38.5 ±5 %		2.40 ±5 %	
3500	37.9 ±5 %		2.91 ±5 %	

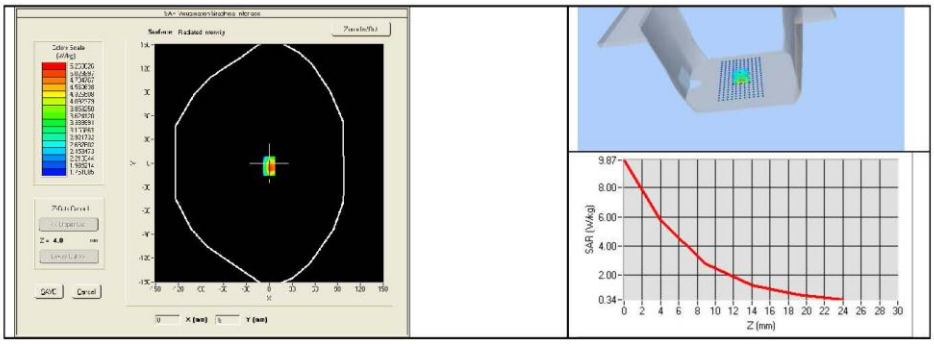
7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

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' : 38.9 sigma : 1.79
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 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	

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

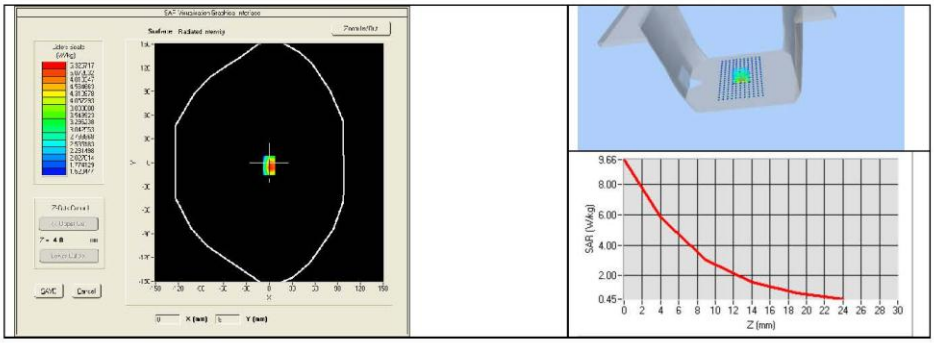
Frequency MHz	Relative permittivity (ε,')		Conductivity (σ) S/m	
	required	measured	required	measured
150	61.9 ±5 %		0.80 ±5 %	
300	58.2 ±5 %		0.92 ±5 %	
450	56.7 ±5 %		0.94 ±5 %	
750	55.5 ±5 %		0.96 ±5 %	
835	55.2 ±5 %		0.97 ±5 %	
900	55.0 ±5 %		1.05 ±5 %	
915	55.0 ±5 %		1.06 ±5 %	
1450	54.0 ±5 %		1.30 ±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' : 52.7 sigma : 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 Humidity	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)



8 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	**Manufacturer / Model**	**Identification No.**	**Current Calibration Date**	**Next Calibration Date**
SAM Phantom	MVG	SN-20/09-SAM71	Validated. No cal required.	Validated. No cal required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rhode & Schwarz ZVA	SN100132	02/2013	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	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 Humidity Sensor	Control Company	11-661-9	8/2012	8/2015

校 准 报 告

CALIBRATION REPORT

报告编号：173205310

客户名称 Name of Customer	：	深圳市巴伦技术股份有限公司
客户地址 Address of Customer	：	深圳市南山区沙河西路白沙科技产业园一楼B区
计量器具名称 Name of Instrument	：	数字多用表
器具用途 Use of Instrument	：	--------
型号/规格 Type/Specification	：	2000
出厂编号 Serial №	：	4024022
资产编号 Asset №	：	BZ-SAR-036
制造单位 Manufacturer	：	KEITHLEY
校准依据 Calibrated in Accordance to	：	参考 JJF 1587-2016 数字多用表校准规范

（校准专用章）
Stamp

校准日期 Operation Date ： 2017 年 Year 06 月 Month 12 日 Day

建议复校日期 Suggested Recal Date： 2018 年 Year 06 月 Month 11 日 Day

批准人 Authorized by ： 王敬喜（技术主管）

签名 Signature ： 王敬喜

核验员 Checked by ： 古建平

校准员 Calibrated by ： 陶东

校准机构备案号：[2012]粤量校F002号
地址：深圳市南山区龙珠大道中段计量质检大楼
电话：0086-755-26941696 0086-755-26941546
传真：0086-755-26941615 0086-755-26941547
邮编：518055 网址：www.smq.com.cn
电子邮件：kfzx@smq.com.cn

Register No.: [2012]粤量校F002号
Add:Metrology and Quality Inspection Building,Central Section of Longzhu Road, Nanshan District,Shenzhen
Tel:0086-755-26941696 0086-755-26941546
Fax:0086-755-26941615 0086-755-26941547
Post Code:518055 http://www.smq.com.cn
E-mail:kfzx@smq.com.cn

校准报告
CALIBRATION REPORT

校准用主要计量标准装置信息
Main Standard Devices Used

名称 Equipment Name	测量范围 Measuring Range	不确定度/准确度等级/最大允许误差 Uncertainty/Accuracy Class/Maximum Permissible Error	计量标准考核证书号 Certificate №	有效期至 Due Date
————	————	————	————	————

校准用主要标准器信息
Main Standards of Measurement Used

名称 Equipment Name	测量范围 Measuring Range	不确定度/准确度等级/最大允许误差 Uncertainty/Accuracy Class/Maximum Permissible Error	设备编号 Equipment №	证书号 Certificate №	有效期至 Due Date
多用表校准源	ACU:(1nV～1100V); DCU:(10nV～1100V); ACI:(1nA～2.2A); DCI:(0.1nA～2.2A); R:(0Ω～100MΩ)	ACU:±0.0075%R;DCU: ±0.0007%R;ACI:±0.014%R; DCI:±0.005%R;R:±0.0012% R	SB0575	检定字第 201608000363号	2017-08-29

附加说明
Appended Directions

委托日期： 2017 年 06 月 12 日
Application Date

校准地点： 客户现场
Operation Location

环境条件： 温度 20 ℃ 相对湿度 60 %
Operation Environment

符合性及限制使用说明： 参见校准结果
Statement of Compliance and Limitation

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1 外观及功能性检查：正常。
Appearance check: Normal

2 直流电压测量示值误差：见表 1
Indication Error of DC Voltage: see Table 1

表 1 直流电压测量示值误差

范围 Range	标准示值 Std. Indication	示值 Indication	误差 Error	最大允许误差 MPE	结论 Conclusion
	(mV)	(mV)	(mV)	(mV)	(Pass or Fail)
100 mV	10.00000	10.0009	0.00090	±0.0040	P
	50.00000	50.0009	0.00090	±0.0060	P
	100.00000	100.0006	0.00060	±0.0085	P
	-100.00000	-99.9992	0.00080	±0.0085	P
	(V)	(V)	(V)	(V)	
1 V	0.10000000	0.100001	0.0000010	±0.000011	P
	0.2000000	0.199999	-0.0000010	±0.000015	P
	0.3000000	0.300000	0.0000000	±0.000019	P
	0.4000000	0.399999	-0.0000010	±0.000023	P
	0.5000000	0.499998	-0.0000020	±0.000027	P
	0.6000000	0.599999	-0.0000010	±0.000031	P
	0.7000000	0.700000	0.0000000	±0.000035	P
	0.8000000	0.799999	-0.0000010	±0.000039	P
	0.9000000	0.899999	-0.0000010	±0.000043	P
	1.0000000	0.999999	-0.0000010	±0.000047	P
	-1.0000000	-0.999998	0.0000020	±0.000047	P
10 V	1.0000000	1.00000	0.000000	±0.00008	P
	5.000000	5.00000	0.000000	±0.00022	P
	10.000000	10.00000	0.000000	±0.00040	P
	-10.000000	-10.00000	0.000000	±0.00040	P
100 V	10.000000	10.0004	0.00040	±0.0010	P
	50.00000	50.0020	0.00200	±0.0028	P
	100.00000	100.0039	0.00390	±0.0051	P
	-100.00000	-100.0037	-0.00370	±0.0051	P

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1000 V	100.00000	100.004	0.0040	±0.014	P
	500.0000	500.022	0.0220	±0.032	P
	900.0000	900.040	0.0400	±0.050	P
	-900.0000	-900.041	-0.0410	±0.050	P

3 交流电压测量示值误差（ f = 1 kHz ）：见表 2
Indication Error of AC Voltage (f = 1 kHz): see Table 2

表 2 交流电压测量示值误差

范围 Range	标准示值 Std. Indication	示值 Indication	误差 Error	最大允许误差 MPE	结论 Conclusion
	(mV)	(mV)	(mV)	(mV)	(Pass or Fail)
100 mV	10.00000	10.000	0.0000	±0.046	P
	50.0000	49.990	-0.0100	±0.070	P
	100.0000	100.004	0.0040	±0.100	P
	(V)	(V)	(V)	(V)	
1 V	0.1000000	0.10002	0.000020	±0.00036	P
	0.500000	0.49993	-0.000070	±0.00060	P
	1.000000	1.00006	0.000060	±0.00090	P
10 V	1.000000	1.0001	0.00010	±0.0036	P
	5.00000	4.9985	-0.00150	±0.0060	P
	10.00000	9.9993	-0.00070	±0.0090	P
100 V	10.00000	10.000	0.0000	±0.036	P
	50.0000	49.986	-0.0140	±0.060	P
	100.0000	99.996	-0.0040	±0.090	P
750 V	100.0000	99.99	-0.010	±0.36	P
	500.000	499.93	-0.070	±0.60	P
	700.000	699.99	-0.010	±0.72	P

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4 直流电流测量示值误差：见表 3
Indication Error of DC Current: see Table 3

表 3 直流电流测量示值误差

范围 Range	标准示值 Std. Indication	示值 Indication	误差 Error	最大允许误差 MPE	结论 Conclusion
	(mA)	(mA)	(mA)	(mA)	(Pass or Fail)
10 mA	1.000000	1.0003	0.00030	±0.0085	P
	5.00000	5.0013	0.00130	±0.0105	P
	10.00000	10.0025	0.00250	±0.0130	P
100 mA	10.00000	10.002	0.0020	±0.085	P
	50.0000	49.999	-0.0010	±0.105	P
	100.0000	99.993	-0.0070	±0.130	P
	(A)	(A)	(A)	(A)	
1 A	0.1000000	0.09999	-0.000010	±0.00088	P
	0.500000	0.49997	-0.000030	±0.00120	P
	1.000000	0.99993	-0.000070	±0.00160	P
3 A	1.000000	0.9999	-0.00010	±0.0016	P
	1.500000	1.4999	-0.00010	±0.0022	P
	1.900000	1.8998	-0.00020	±0.0027	P

5 交流电流测量示值误差(f = 1 kHz)：见表 4
Indication Error of AC Current(f = 1 kHz): see Table 4

表 4 交流电流测量示值误差

范围 Range	标准示值 Std. Indication	示值 Indication	误差 Error	最大允许误差 MPE	结论 Conclusion
	(A)	(A)	(A)	(A)	(Pass or Fail)
1 A	0.100000	0.09999	-0.000010	±0.00050	P
	0.50000	0.49989	-0.00011	±0.00090	P
	1.00000	0.99997	-0.00003	±0.00140	P

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3 A	1.00000	0.9996	-0.00040	±0.0021	P
	1.50000	1.4996	-0.00040	±0.0028	P
	1.90000	1.8997	-0.00030	±0.0034	P

6 电阻测量示值误差：见表 5
Indication Error of Resistance: see Table 5

表 5 电阻测量示值误差

范围 Range	标准示值 Std. Indication	示值 Indication	误差 Error	最大允许误差 MPE	结论 Conclusion
	(Ω)	(Ω)	(Ω)	(Ω)	(Pass or Fail)
100 Ω	100.00000	99.993	-0.0070	±0.014	P
	(kΩ)	(kΩ)	(kΩ)	(kΩ)	
1 kΩ	1.0000310	0.99997	-0.000061	±0.0002	P
10 kΩ	9.999910	10.0001	0.00019	±0.0011	P
100 kΩ	99.99710	100.000	0.0029	±0.011	P
	(MΩ)	(MΩ)	(MΩ)	(MΩ)	
1 MΩ	0.9999570	0.99998	0.000023	±0.00011	P
10 MΩ	9.998700	9.9983	-0.00040	±0.0041	P

注： 1 本次测量不确定度说明：
Notes： Uncertainty in the Measurement

1.1 依据 JJF 1059.1-2012 测量不确定度评定与表示
According to JJF 1059.1-2012 Evaluation and Expression of Uncertainty in Measurement.

1.2 直流电压测量结果的相对扩展不确定度： $U_{rel} = 0.002\ \%$， $k = 2$
Related Expanded Uncertainty of DC Voltage Measurement Results

1.3 交流电压测量结果的相对扩展不确定度： $U_{rel} = 0.01\ \%$， $k = 2$
Related Expanded Uncertainty of AC Voltage Measurement Results

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1.4 直流电流测量结果的相对扩展不确定度： $U_{rel} = 0.005\ \%$， $k = 2$
Related Expanded Uncertainty of DC Current Measurement Results

1.5 交流电流测量结果的相对扩展不确定度： $U_{rel} = 0.02\ \%$， $k = 2$
Related Expanded Uncertainty of AC Current Measurement Results

1.6 电阻测量结果的相对扩展不确定度： $U_{rel} = 0.003\ \%$， $k = 2$
Related Expanded Uncertainty of Resistance Measurement Results

2 结论判断依据：仪器说明书技术要求。
Basis for the conclusion: Technical Specification of the Instrument.
