

7.1 HEAD LIQUID MEASUREMENT

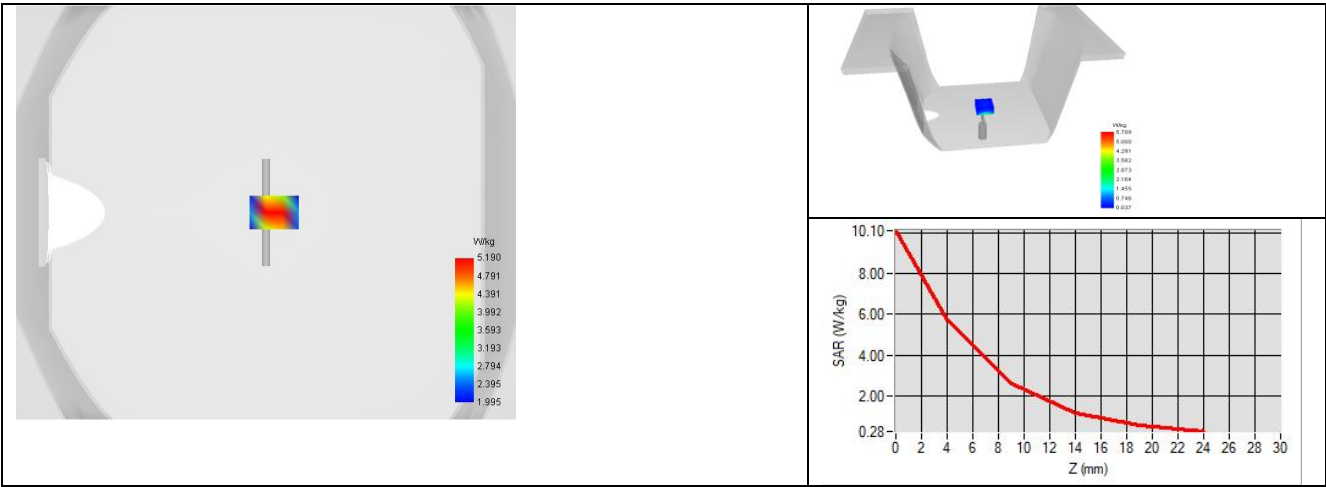
Frequency MHz	Relative permittivity (ϵ_r')		Conductivity (σ) S/m	
	required	measured	required	measured
300	45.3 $\pm$ 10 %		0.87 $\pm$ 10 %	
450	43.5 $\pm$ 10 %		0.87 $\pm$ 10 %	
750	41.9 $\pm$ 10 %		0.89 $\pm$ 10 %	
835	41.5 $\pm$ 10 %		0.90 $\pm$ 10 %	
900	41.5 $\pm$ 10 %		0.97 $\pm$ 10 %	
1450	40.5 $\pm$ 10 %		1.20 $\pm$ 10 %	
1500	40.4 $\pm$ 10 %		1.23 $\pm$ 10 %	
1640	40.2 $\pm$ 10 %		1.31 $\pm$ 10 %	
1750	40.1 $\pm$ 10 %		1.37 $\pm$ 10 %	
1800	40.0 $\pm$ 10 %		1.40 $\pm$ 10 %	
1900	40.0 $\pm$ 10 %		1.40 $\pm$ 10 %	
1950	40.0 $\pm$ 10 %		1.40 $\pm$ 10 %	
2000	40.0 $\pm$ 10 %		1.40 $\pm$ 10 %	
2100	39.8 $\pm$ 10 %		1.49 $\pm$ 10 %	
2300	39.5 $\pm$ 10 %		1.67 $\pm$ 10 %	
2450	39.2 $\pm$ 10 %	36.4	1.80 $\pm$ 10 %	1.96
2600	39.0 $\pm$ 10 %		1.96 $\pm$ 10 %	
3000	38.5 $\pm$ 10 %		2.40 $\pm$ 10 %	
3300	38.2 $\pm$ 10 %		2.71 $\pm$ 10 %	
3500	37.9 $\pm$ 10 %		2.91 $\pm$ 10 %	
3700	37.7 $\pm$ 10 %		3.12 $\pm$ 10 %	
3900	37.5 $\pm$ 10 %		3.32 $\pm$ 10 %	
4200	37.1 $\pm$ 10 %		3.63 $\pm$ 10 %	
4600	36.7 $\pm$ 10 %		4.04 $\pm$ 10 %	
4900	36.3 $\pm$ 10 %		4.35 $\pm$ 10 %	

7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 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 V5
Phantom	SN 13/09 SAM68
Probe	SN 41/18 EPGO333
Liquid	Head Liquid Values: ϵ_p : 36.4 σ : 1.96
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	2450 MHz
Input power	20 dBm
Liquid Temperature	20 +/- 1 °C
Lab Temperature	20 +/- 1 °C
Lab Humidity	30-70 %

Frequency MHz	1 g SAR (W/kg/W)		10 g SAR (W/kg/W)	
	required	measured	required	measured
300	2.85		1.94	
450	4.58		3.06	
750	8.49		5.55	
835	9.56		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	54.40 (5.44)	24	23.86 (2.39)
2600	55.3		24.6	
3000	63.8		25.7	
3300	-		-	
3500	67.1		25	
3700	67.4		24.2	
3900	-		-	
4200	-		-	
4600	-		-	
4900	-		-	



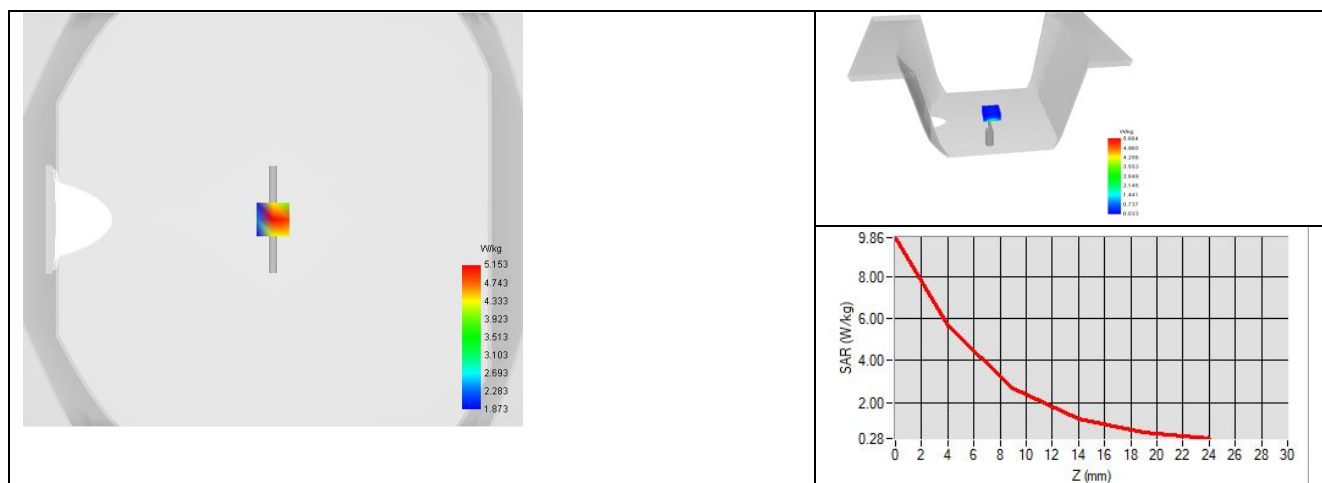
7.3 BODY LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ϵ_r')		Conductivity (σ) S/m	
	required	measured	required	measured
150	61.9 $\pm$ 10 %		0.80 $\pm$ 10 %	
300	58.2 $\pm$ 10 %		0.92 $\pm$ 10 %	
450	56.7 $\pm$ 10 %		0.94 $\pm$ 10 %	
750	55.5 $\pm$ 10 %		0.96 $\pm$ 10 %	
835	55.2 $\pm$ 10 %		0.97 $\pm$ 10 %	
900	55.0 $\pm$ 10 %		1.05 $\pm$ 10 %	
915	55.0 $\pm$ 10 %		1.06 $\pm$ 10 %	
1450	54.0 $\pm$ 10 %		1.30 $\pm$ 10 %	
1610	53.8 $\pm$ 10 %		1.40 $\pm$ 10 %	
1800	53.3 $\pm$ 10 %		1.52 $\pm$ 10 %	
1900	53.3 $\pm$ 10 %		1.52 $\pm$ 10 %	
2000	53.3 $\pm$ 10 %		1.52 $\pm$ 10 %	
2100	53.2 $\pm$ 10 %		1.62 $\pm$ 10 %	
2300	52.9 $\pm$ 10 %		1.81 $\pm$ 10 %	
2450	52.7 $\pm$ 10 %	53.4	1.95 $\pm$ 10 %	2.14
2600	52.5 $\pm$ 10 %		2.16 $\pm$ 10 %	
3000	52.0 $\pm$ 10 %		2.73 $\pm$ 10 %	
3300	51.6 $\pm$ 10 %		3.08 $\pm$ 10 %	
3500	51.3 $\pm$ 10 %		3.31 $\pm$ 10 %	
3700	51.0 $\pm$ 10 %		3.55 $\pm$ 10 %	
3900	50.8 $\pm$ 10 %		3.78 $\pm$ 10 %	
4200	50.4 $\pm$ 10 %		4.13 $\pm$ 10 %	
4600	49.8 $\pm$ 10 %		4.60 $\pm$ 10 %	
4900	49.4 $\pm$ 10 %		4.95 $\pm$ 10 %	
5200	49.0 $\pm$ 10 %		5.30 $\pm$ 10 %	
5300	48.9 $\pm$ 10 %		5.42 $\pm$ 10 %	
5400	48.7 $\pm$ 10 %		5.53 $\pm$ 10 %	
5500	48.6 $\pm$ 10 %		5.65 $\pm$ 10 %	
5600	48.5 $\pm$ 10 %		5.77 $\pm$ 10 %	
5800	48.2 $\pm$ 10 %		6.00 $\pm$ 10 %	

7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

Software	OPENSAR V5
Phantom	SN 13/09 SAM68
Probe	SN 41/18 EPG0333
Liquid	Body Liquid Values: ϵ_{ps}' : 53.4 σ : 2.14
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	2450 MHz
Input power	20 dBm
Liquid Temperature	20 +/- 1 °C
Lab Temperature	20 +/- 1 °C
Lab Humidity	30-70 %

Frequency MHz	1 g SAR (W/kg/W)	10 g SAR (W/kg/W)
	measured	measured
2450	53.84 (5.38)	23.26 (2.33)



8 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	Manufacturer / Model	Identification No.	Current Calibration Date	Next Calibration Date
SAM Phantom	MVG	SN 13/09 SAM68	Validated. No cal required.	Validated. No cal required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rohde & Schwarz ZVM	100203	08/2021	08/2024
Network Analyzer	Agilent 8753ES	MY40003210	10/2021	10/2024
Network Analyzer – Calibration kit	Rohde & Schwarz ZV-Z235	101223	05/2021	05/2024
Network Analyzer – Calibration kit	HP 85033D	3423A08186	06/2021	06/2027
Calipers	Mitutoyo	SN 0009732	10/2021	10/2024
Reference Probe	MVG	SN 41/18 EPGO333	10/2021	10/2024
Multimeter	Keithley 2000	1160271	02/2021	02/2024
Signal Generator	Rohde & Schwarz SMB	106589	04/2021	04/2024
Amplifier	MVG	MODU-023-C-0002	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	NI-USB 5680	170100013	06/2021	06/2024
Power Meter	Rohde & Schwarz NRVD	832839-056	11/2021	11/2024
Directional Coupler	Krytar 158020	131467	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Temperature / Humidity Sensor	Testo 184 H1	44225320	06/2021	06/2024



校准证书

CALIBRATION CERTIFICATE



证书编号:
Certificate No. S424079462

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客户信息

Customer Information

客户名称:
Name

信恒检测技术(深圳)有限公司

客户地址:
Address

深圳市宝安区松岗街道潭头社区潭头工业城二区1栋厂房101.201.301

被校测量 器具信息

Information of
Instrument under
Calibration

仪器名称:
Description

Coaxial mechanical calibration parts同轴机械校准件

型号规格:
Model/Type

50Ω 35mm 9G

制造厂商:
Manufacturer

南京普纳科技设备有限公司

出厂编号:
Serial No.

/

管理编号:
Asset No.

BTF-EM-068

接收日期:
Received Date

2024 / 10 / 25

接收状态:
As Received

正常/Normal

结论:
Conclusion

参照检测/校准结果使用。

The test or calibration results are referred to evaluate the validity of instrument measurement.



扫一扫查真伪

证书有效性声明:

- 1、证书首页盖有证书章
- 2、证书须有唯一防伪码
- 3、扫描信息与证书一致

校准日期: 2024 / 10 / 25
Cal. Date

签发日期: 2024 / 10 / 30
Issue Date

建议复校日期: 2025 / 10 / 24
Next Cal. Date

校准: 刘金辉
Calibrated by

核验: 何聪
Inspected by

签发: 杨帆
Approved by (总经理助理)



校准说明

CALIBRATION DIRECTIONS

证书编号: S424079462
Certificate No.

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- 本公司实验室经中国合格评定国家认可委员会审核,符合ISO/IEC17025《检测和校准实验室能力的通用要求》的要求,认可证书号: No.L3103。
This laboratory is accredited to ISO/IEC 17025《Requirements for the competence of Testing and Calibration Laboratories》,CNAS Accreditation Certificate No.L3103.
- 本证书中的校准结果均可溯源至国际单位制(SI)单位。
The calibration results in this certificate are traceable to International System of Units(SI)
- 对本次校准若有异议,委托方应于收到被件之日起十五日内向本公司提出。
If there is any objection concerning the calibration, the Client should inform the issuing company within 15 days from the date of the device under test return to the client.
- 未经本公司许可,不得部分复印、摘用或篡改本证书的内容。
This report may not be reproduced, except in full, without the written approval of CCIC (ShenZhen) Metrology & Testing Service Co.,Ltd.
- 本证书校准结果只与被校准仪器有关,带'*'号的校准项目或参数不在本公司实验室认可范围内。
The results reported here in apply only to the calibrated equipment, Calibration items or parameter with '*' is beyond the scope of our laboratory accreditation.
- 本次校准的技术依据:
Procedures for the Calibration:

参照 JJF 1495-2014《矢量网络分析仪校准规范》 C.S. for Vector network analyzer

JJF(军工)76-2014《微波二端口器件校准规范》 C.S. for Two-port Microwave Devices

- 本次校准所使用的主要标准器具:
Standards Used in the Calibration:

器具名称/型号规格 Instrument Description/Model	编号 Asset No.	证书编号 Certificate No.	有效期 Due Date	计量特性 Metrological Characteristic	溯源机构 Traceability institutions
网络分析仪/Vector Network Analyzer E5071C	CCIC-WX-1024	JL2402278931	2025/02/05	Sij模值: $U=0.12\text{dB}$; Sij相位: $U=0.9^\circ$; VSWR: $U=0.030$; ($k=2$)	深圳计量院
N型校准套件/Type-N Calibration Kit 85054B	CCIC-WX-1006	GFJGJL100222007 8220	2025/04/28	Reflection: $U=0.02$ ($k=2$); Phase: $U=1^\circ$ ($k=2$);	二〇三所

- 校准地点和环境条件:

Place and environmental conditions:

地点: 客户现场 实验室

Place of Calibration

温度: (22.5 ~ 23) °C

Temperature

相对湿度: (55 ~ 60) %

Relative Humidity



校准结果

CALIBRATION RESULT

证书编号：S424079462
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- 1、外观及正常性检查：正常
Check on Appearance and Function: Pass

- 2、50Ω负载驻波比
50Ω load VSWR

频率	实测值
Frequency	Measured
(MHz)	/
10	1.004
50	1.005
100	1.007
200	1.006
500	1.007
1000	1.011
2000	1.012
3000	1.018
4000	1.021
5000	1.023
6000	1.023
7000	1.019
8000	1.016
9000	1.017

- 3、开路反射
Open circuit reflex

频率	实测值
Frequency	Measured
(MHz)	/
10	1.000
50	1.000
100	1.000
200	1.000



校准结果

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500	1.000
1000	1.000
2000	0.999
3000	0.998
4000	0.995
5000	0.993
6000	0.991
7000	0.989
8000	0.987
9000	0.987

4、开路相位

Open phase

频率 Frequency (MHz)	实测值 Measured (°)
10	-0.22
50	-1.12
100	-2.23
200	-4.42
500	-11.10
1000	-22.27
2000	-44.37
3000	-67.00
4000	-89.40
5000	-111.91
6000	-134.79
7000	-157.98
8000	179.05
9000	155.91

5、短路反射



校准结果

CALIBRATION RESULT

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Short circuit reflex

频率	实测值
Frequency	Measured
(MHz)	/
10	0.999
50	0.998
100	0.997
200	0.996
500	0.994
1000	0.990
2000	0.988
3000	0.988
4000	0.988
5000	0.988
6000	0.990
7000	0.992
8000	0.990
9000	0.992

6、短路相位

Short phase

频率	实测值
Frequency	Measured
(MHz)	(°)
10	179.74
50	178.69
100	177.44
200	175.02
500	167.80
1000	155.90
2000	132.22



校准结果

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3000	108.77
4000	89.80
5000	62.70
6000	40.54
7000	18.00
8000	-4.05
9000	-26.09

说明(Notes)

1、本次校准的测量不确定度

Measurement Uncertainty in Calibration

1.1 依据JJF 1059.1-2012 测量不确定度评定与表示

Conform JJF 1059.1-2012 *Evaluation and Expression of Uncertainty in Measurement*.

1.2 本次测量结果的扩展不确定度 ($k=2$)

The Expanded Uncertainty of the Measurement Results

—— 反射系数相位(Reflective Phase)	$U = 1.7^{\circ}$
—— 反射系数模值 (Reflective Properties)	$U = 0.029$

以下空白

End of Report



Dielectric Probe Calibration Report

Ref : ACR.41.5.25.BES.A

BTF TESTING LAB (SHENZHEN) CO., LTD.
F101,201 AND 301, BUILDING 1, BLOCK 2, TANTOU
INDUSTRIAL PARK, TANTOU COMMUNITY
SONGGANG STREET, BAO'AN DISTRICT, SHENZHEN,
CHINA

MVG LIMESAR DIELECTRIC PROBE

FREQUENCY: 0.15-7.5 GHZ

SERIAL NO.: SN 06/22 OCPG 88

Calibrated at MVG

Z.I. de la pointe du diable

Technopôle Brest Iroise – 295 avenue Alexis de Rochon

29280 PLOUZANE - FRANCE

Calibration date: 02/05/2025



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

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Summary:

This document presents the method and results from an accredited Dielectric Probe calibration performed at MVG, using the LIMESAR test bench. The test results covered by accreditation are traceable to the International System of Units (SI).



SAR DIELECTRIC PROBE CALIBRATION REPORT

Ref: ACR.41.5.25.BES.A

	<i>Name</i>	<i>Function</i>	<i>Date</i>	<i>Signature</i>
<i>Prepared by :</i>	Pedro Ruiz	Technical Manager	2/10/2025	
<i>Checked & approved by:</i>	Pedro Ruiz	Technical Manager	2/10/2025	
<i>Authorized by:</i>	Geraldine Toutain	Quality Manager	2/10/2025	

DocuSigned by:
Géraldine TOUTAIN
 A1C9AC91CB5441A...

	<i>Customer Name</i>
<i>Distribution :</i>	BTF Testing Lab (Shenzhen) Co., Ltd.

<i>Issue</i>	<i>Name</i>	<i>Date</i>	<i>Modifications</i>
A	Pedro Ruiz	2/10/2025	Initial release



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 6.1 Liquid complex Permittivity Measurement 5

7 List of Equipment 7



1 INTRODUCTION

This document contains a summary of the suggested methods and requirements set forth by the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards for liquid permittivity measurements and the measurements that were performed to verify that the product complies with the fore mentioned standards.

2 DEVICE UNDER TEST

Device Under Test	
Device Type	LIMESAR DIELECTRIC PROBE
Manufacturer	MVG
Model	SCLMP
Serial Number	SN 06/22 OCPG 88
Product Condition (new / used)	Used

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

MVG's Dielectric Probes are built in accordance to the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards. The product is designed for use with the LIMESAR test bench only.



Figure 1 – MVG LIMESAR Dielectric Probe



4 MEASUREMENT METHOD

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards outline techniques for dielectric property measurements. The LIMESAR test bench employs one of the methods outlined in the standards, using a contact probe or open-ended coaxial transmission-line probe and vector network analyzer. The standards recommend the measurement of two reference materials that have well established and stable dielectric properties to validate the system, one for the calibration and one for checking the calibration. The LIMESAR test bench uses De-ionized water as the reference for the calibration and either Ethanediol or Methanol as the reference for checking the calibration. The following measurements were performed to verify that the product complies with the fore-mentioned standards.

4.1 LIQUID COMPLEX PERMITTIVITY MEASUREMENTS

The complex permittivity of a liquid with known dielectric properties was measured and the measurement results compared to the values provided in the fore mentioned standards.

5 MEASUREMENT UNCERTAINTY

The guidelines outlined in the IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards were followed to generate the measurement uncertainty associated with a SAR probe calibration using the waveguide or calorimetric cell technique depending on the frequency.

The estimated expanded uncertainty (k=2) in calibration for relative permittivity is +/-10% with respect to measurement conditions.

The estimated expanded uncertainty (k=2) in calibration for conductivity (S/m) is +/-8.2% with respect to measurement conditions.

6 CALIBRATION RESULTS

Measurement Condition

Software	LIMESAR
Liquid Temperature	20 +/- 1 °C
Lab Temperature	20 +/- 1 °C
Lab Humidity	30-70 %

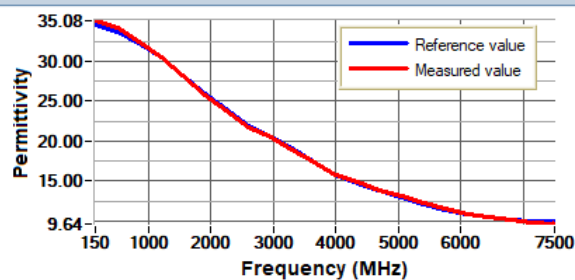
6.1 LIQUID COMPLEX PERMITTIVITY MEASUREMENT

A liquid of known characteristics (methanol or ethanediol) is measured with the probe and the results (complex permittivity $\epsilon' + j\epsilon''$) are compared with the reference values for this liquid.

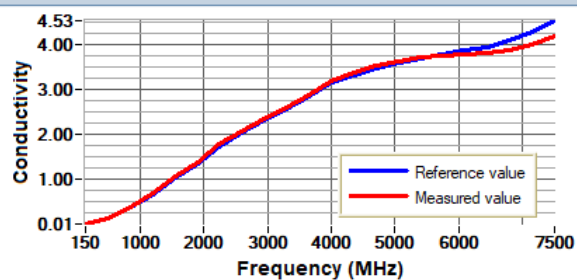


SAR DIELECTRIC PROBE CALIBRATION REPORT

Ref: ACR.41.5.25.BES.A



Frequency (MHz)	Methanol Permittivity (Reference)	Methanol Permittivity (Measure)	Difference (%)	Limit (+/- %)
150	34.52	35.08	-1.6	10.0
500	33.73	34.18	-1.3	10.0
850	32.20	32.49	-0.9	10.0
1200	30.57	30.52	0.2	10.0
1550	28.17	28.17	0.0	10.0
1900	25.91	25.81	0.4	10.0
2250	24.02	23.86	0.7	10.0
2600	22.00	21.79	0.9	10.0
2950	20.53	20.43	0.5	10.0
3300	19.03	18.95	0.4	10.0
3650	17.44	17.44	-0.0	10.0
4000	15.76	15.84	-0.5	10.0
4350	14.75	14.84	-0.5	10.0
4700	13.82	13.92	-0.7	10.0
5050	12.97	13.08	-0.9	10.0
5400	12.18	12.27	-0.8	10.0
5750	11.44	11.51	-0.6	10.0
6100	10.88	10.90	-0.2	10.0
6450	10.52	10.47	0.4	10.0
6800	10.23	10.11	1.3	10.0
7150	10.06	9.81	2.5	10.0
7500	10.01	9.64	3.7	10.0



Frequency (MHz)	Methanol Conductivity (Reference)	Methanol Conductivity (Measure)	Difference (%)	Limit (+/- %)
150	0.01	0.01	-5.5	8.2
500	0.14	0.15	-7.0	8.2
850	0.37	0.39	-5.7	8.2
1200	0.67	0.69	-3.4	8.2
1550	1.04	1.08	-4.2	8.2
1900	1.36	1.40	-2.9	8.2
2250	1.74	1.79	-2.9	8.2
2600	2.04	2.07	-1.7	8.2
2950	2.32	2.35	-1.3	8.2
3300	2.57	2.61	-1.5	8.2
3650	2.84	2.88	-1.4	8.2
4000	3.15	3.20	-1.6	8.2
4350	3.33	3.38	-1.7	8.2
4700	3.48	3.52	-1.2	8.2
5050	3.60	3.63	-0.8	8.2
5400	3.70	3.71	-0.2	8.2
5750	3.78	3.74	1.0	8.2
6100	3.87	3.78	2.2	8.2
6450	3.95	3.81	3.6	8.2
6800	4.09	3.88	5.0	8.2
7150	4.29	4.01	6.5	8.2
7500	4.53	4.19	7.6	8.2



SAR DIELECTRIC PROBE CALIBRATION REPORT

Ref: ACR.41.5.25.BES.A

7 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	Manufacturer / Model	Identification No.	Current Calibration Date	Next Calibration Date
LIMESAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Liquid measurement probe	MVG	SN 35/10 OCPG37	01/2025	02/2026
Network Analyzer	Rohde & Schwarz ZVM	100203	08/2021	08/2026
Network Analyzer – Calibration kit	Rohde & Schwarz ZV-Z235	101223	07/2022	07/2027
Temperature / Humidity Sensor	Testo 184 H1	44235403	10/2024	10/2027