

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) | New |

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 DMS 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 PERMITTIVITY MEASUREMENTS

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

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 DIELECTRIC PERMITTIVITY MEASUREMENT

The following uncertainties apply to the Dielectric Permittivity measurement:

| Uncertainty analysis of Permittivity Measurement | | | | | |
|---|--------------------------|--------------------------|---------|----|-----------------------------|
| ERROR SOURCES | Uncertainty value (+/-%) | Probability Distribution | Divisor | ci | Standard Uncertainty (+/-%) |
| Expanded uncertainty (confidence level of 95%, k = 2) | | | | | 10 % |

| Uncertainty analysis of Conductivity Measurement | | | | | |
|---|--------------------------|--------------------------|---------|----|-----------------------------|
| ERROR SOURCES | Uncertainty value (+/-%) | Probability Distribution | Divisor | ci | Standard Uncertainty (+/-%) |
| Expanded uncertainty (confidence level of 95%, k = 2) | | | | | 8.2% |

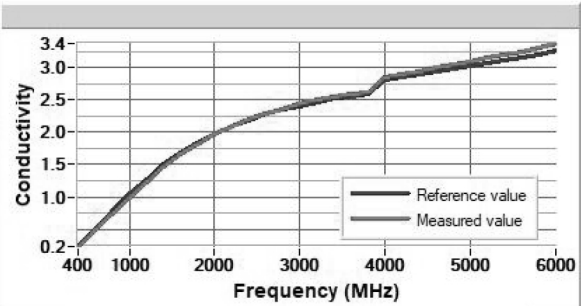
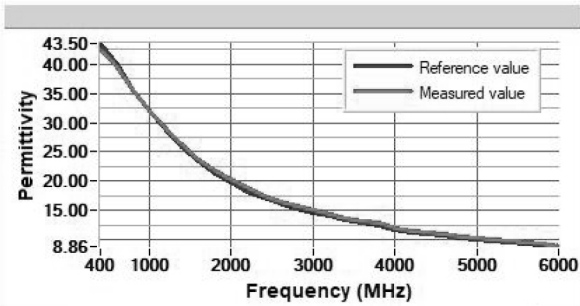
6 CALIBRATION MEASUREMENT RESULTS

Measurement Condition

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

6.1 LIQUID 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.



| Frequency (MHz) | Ethanediol Permittivity (Reference) | Ethanediol Permittivity (Measure) | Difference (%) | Limit (+/- %) |
|-----------------|-------------------------------------|-----------------------------------|----------------|---------------|
| 400 | 43.50 | 42.34 | 2.2 | 10.0 |
| 600 | 39.92 | 39.37 | 1.4 | 10.0 |
| 800 | 35.68 | 35.51 | 0.3 | 10.0 |
| 1000 | 31.98 | 32.06 | -0.2 | 10.0 |
| 1200 | 28.77 | 29.01 | -0.8 | 10.0 |
| 1400 | 25.86 | 26.26 | -1.6 | 10.0 |
| 1600 | 23.36 | 22.78 | -1.8 | 10.0 |
| 1800 | 21.33 | 21.68 | -1.7 | 10.0 |
| 2000 | 19.78 | 20.82 | -3.2 | 10.0 |
| 2200 | 18.27 | 18.78 | -2.8 | 10.0 |
| 2400 | 17.17 | 17.48 | -1.8 | 10.0 |
| 2600 | 16.16 | 16.79 | -2.0 | 10.0 |
| 2800 | 15.29 | 15.74 | -2.9 | 10.0 |
| 3000 | 14.60 | 14.97 | -2.5 | 10.0 |
| 3200 | 14.03 | 14.51 | -2.0 | 10.0 |
| 3400 | 13.49 | 13.75 | -1.9 | 10.0 |
| 3600 | 12.95 | 13.24 | -2.3 | 10.0 |
| 3800 | 12.53 | 12.83 | -2.3 | 10.0 |
| 4000 | 11.62 | 11.29 | -2.3 | 10.0 |
| 4200 | 11.28 | 11.53 | -2.3 | 10.0 |
| 4400 | 10.97 | 11.23 | -2.3 | 10.0 |
| 4600 | 10.68 | 10.96 | -2.1 | 10.0 |
| 4800 | 10.40 | 10.60 | -1.9 | 10.0 |
| 5000 | 10.11 | 10.39 | -1.8 | 10.0 |
| 5200 | 9.85 | 10.01 | -1.7 | 10.0 |
| 5400 | 9.59 | 9.73 | -1.5 | 10.0 |
| 5600 | 9.35 | 9.48 | -1.5 | 10.0 |
| 5800 | 9.14 | 9.25 | -1.0 | 10.0 |
| 6000 | 8.86 | 8.95 | -1.0 | 10.0 |

| Frequency (MHz) | Ethanediol Conductivity (Reference) | Ethanediol Conductivity (Measure) | Difference (%) | Limit (+/- %) |
|-----------------|-------------------------------------|-----------------------------------|----------------|---------------|
| 400 | 0.24 | 0.23 | 3.5 | 8.2 |
| 600 | 0.50 | 0.46 | 6.9 | 8.2 |
| 800 | 0.78 | 0.74 | 5.4 | 8.2 |
| 1000 | 1.05 | 1.00 | 4.6 | 8.2 |
| 1200 | 1.27 | 1.20 | 3.4 | 8.2 |
| 1400 | 1.50 | 1.47 | 1.8 | 8.2 |
| 1600 | 1.69 | 1.64 | 1.8 | 8.2 |
| 1800 | 1.84 | 1.81 | 2.0 | 8.2 |
| 2000 | 1.97 | 1.94 | 0.4 | 8.2 |
| 2200 | 2.09 | 2.09 | 0.1 | 8.2 |
| 2400 | 2.19 | 2.22 | -0.8 | 8.2 |
| 2600 | 2.29 | 2.29 | 0.1 | 8.2 |
| 2800 | 2.36 | 2.34 | -0.1 | 8.2 |
| 3000 | 2.41 | 2.44 | -1.2 | 8.2 |
| 3200 | 2.47 | 2.50 | -1.5 | 8.2 |
| 3400 | 2.52 | 2.55 | -1.0 | 8.2 |
| 3600 | 2.56 | 2.59 | -1.3 | 8.2 |
| 3800 | 2.59 | 2.61 | -1.3 | 8.2 |
| 4000 | 2.81 | 2.85 | -1.5 | 8.2 |
| 4200 | 2.85 | 2.90 | -1.8 | 8.2 |
| 4400 | 2.89 | 2.94 | -1.7 | 8.2 |
| 4600 | 2.95 | 3.01 | -2.1 | 8.2 |
| 4800 | 3.00 | 3.06 | -2.1 | 8.2 |
| 5000 | 3.03 | 3.11 | -2.3 | 8.2 |
| 5200 | 3.07 | 3.15 | -2.6 | 8.2 |
| 5400 | 3.12 | 3.20 | -2.7 | 8.2 |
| 5600 | 3.15 | 3.25 | -3.0 | 8.2 |
| 5800 | 3.21 | 3.30 | -3.0 | 8.2 |
| 6000 | 3.26 | 3.38 | -3.5 | 8.2 |



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 | 11/2022 | 11/2023 |
| 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 |
| Temperature / Humidity Sensor | Testo 184 H1 | 44225320 | 06/2021 | 06/2024 |



中国检验认证集团

CHINA CERTIFICATION & INSPECTION GROUP

中检(深圳)计量测试服务有限公司

CCIC (Shenzhen) Metrology & Testing Service Co.,Ltd



中国认可
国际互认
校准
CALIBRATION
CNAS L3103

校准证书

CALIBRATION CERTIFICATE



证书编号:



Certificate No.

S423066282

第 1 页 共 6 页

Page of

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

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

2023 / 11 / 16

接收状态:

As Received

正常

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: 2023 / 11 / 16

Cal.Date

签发日期: 2023 / 11 / 17

Issue Date

建议复校日期: 2024 / 11 / 15

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)

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Addr: ShengHui Hongxing Chuangzhi Square, Tongren Road, Tianliao

Community, Yutang Street, Guangming District, Shenzhen

邮政编码(Post No.): 518107

网址(Web): <http://www.ccic-mts.com>

电话(Tel): 0755-86139118

传真(Fax): 0755-86139110

邮箱(e-mail): Calibration@sz.ccic.com



校准说明

CALIBRATION DIRECTIONS

证书编号: S423066282
Certificate No.

第 2 页 共 6 页
Page of

1. 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.

2. 对本次校准若有异议,委托方应于收到被校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.

3. 未经本公司许可,不得部分复印、摘用或篡改本证书的内容。

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4. 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.

5. 本次校准的技术依据:

Procedures for the Calibration:

| |
|---|
| 参照JJG(电子)306001-2006《射频同轴阻抗标准器检定规程》 V.R. of RF Coaxial Impedance standard |
| 参照 JZM 35118J-2017《微波元器件校准方法》 Microwave components calibration method |
| |
| |
| |

6. 本次校准所使用的主要标准器具:

Standards Used in the Calibration:

| 器具名称 Instrument Description | 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 | CCIC-WX-1024 | JL2315557151 | 2024/03/13 | 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 | CCIC-WX-1006 | GFJGJL1002220078 220 | 2025/04/28 | Reflection: $U=0.02$ ($k=2$); Phase: $U=1^\circ$ ($k=2$); | 二〇三所 |

7. 校准地点和环境条件:

Place and environmental conditions:

地点: 客户现场 实验室 温度: (23.5 ~ 24.5)°C 相对湿度: (58 ~ 68)%

Place of Calibration

Temperature

Relative Humidity



校准结果

CALIBRATION RESULT

证书编号: S423066282
Certificate No.

第 3 页 共 6 页
Page of

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 Frequency (MHz) | 实测值 Measured |
|----------------------------|-----------------|
| | / |
| 10 | 1.004 |
| 50 | 1.003 |
| 100 | 1.005 |
| 200 | 1.005 |
| 500 | 1.006 |
| 1000 | 1.009 |
| 2000 | 1.012 |
| 3000 | 1.017 |
| 4000 | 1.021 |
| 5000 | 1.023 |
| 6000 | 1.021 |
| 7000 | 1.018 |
| 8000 | 1.015 |
| 9000 | 1.017 |

3、开路反射

Open circuit reflex

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



校准结果

CALIBRATION RESULT

证书编号: S423066282
Certificate No.

第 4 页 共 6 页
Page of

| | |
|------|-------|
| 500 | 1.000 |
| 1000 | 1.000 |
| 2000 | 0.999 |
| 3000 | 0.998 |
| 4000 | 0.996 |
| 5000 | 0.994 |
| 6000 | 0.992 |
| 7000 | 0.989 |
| 8000 | 0.988 |
| 9000 | 0.987 |

4、开路相位

Open phase

| 频率 Frequency (MHz) | 实测值 Measured (°) |
|----------------------------|--------------------------|
| 10 | -0.23 |
| 50 | -1.11 |
| 100 | -2.22 |
| 200 | -4.43 |
| 500 | -11.10 |
| 1000 | -22.27 |
| 2000 | -44.38 |
| 3000 | -66.99 |
| 4000 | -89.40 |
| 5000 | -111.92 |
| 6000 | -134.79 |
| 7000 | -157.97 |
| 8000 | 179.05 |
| 9000 | 155.91 |

5、短路反射



校准结果

CALIBRATION RESULT

证书编号: S423066282
Certificate No.

第 5 页 共 6 页
Page of

Short circuit reflex

| 频率 Frequency (MHz) | 实测值 Measured |
|----------------------------|-----------------|
| | / |
| 10 | 0.999 |
| 50 | 0.999 |
| 100 | 0.997 |
| 200 | 0.997 |
| 500 | 0.995 |
| 1000 | 0.990 |
| 2000 | 0.988 |
| 3000 | 0.987 |
| 4000 | 0.988 |
| 5000 | 0.987 |
| 6000 | 0.989 |
| 7000 | 0.991 |
| 8000 | 0.991 |
| 9000 | 0.992 |

6、短路相位

Short phase

| 频率 Frequency (MHz) | 实测值 Measured (°) |
|----------------------------|--------------------------|
| 10 | 179.72 |
| 50 | 178.71 |
| 100 | 177.46 |
| 200 | 175.00 |
| 500 | 167.82 |
| 1000 | 155.88 |
| 2000 | 132.23 |



校准结果

CALIBRATION RESULT

证书编号: S423066282
Certificate No.

第 6 页 共 6 页
Page of

| | |
|------|--------|
| 3000 | 108.78 |
| 4000 | 89.78 |
| 5000 | 62.69 |
| 6000 | 40.52 |
| 7000 | 18.02 |
| 8000 | -4.03 |
| 9000 | -26.07 |

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