



SAR Reference Dipole Calibration Report

Ref : ACR.60.33.21.MVGB.A

SHENZHEN STS TEST SERVICES CO., LTD.
1/F, BUILDING 2, ZHUOKE SCIENCE PARK, CHONGQING
ROAD

FUYONG, BAO' AN DISTRICT, SHENZHEN, CHINA

MVG LINESAR DIELECTRIC PROBE

FREQUENCY: 0.3-6 GHZ

SERIAL NO.: SN 32/14 OCPG67

Calibrated at MVG

Z.I. de la pointe du diable

Technopôle Brest Iroise – 295 avenue Alexis de Rochon

29280 PLOUZANE - FRANCE

Calibration date: 11/23/2021



Accreditations #2-6789 and #2-6814
Scope available on www.cofrac.fr

Summary:

This document presents the method and results from an accredited dielectric probe calibration performed in MVG using the LINESAR test bench. All calibration results are traceable to national metrology institutions.

	<i>Name</i>	<i>Function</i>	<i>Date</i>	<i>Signature</i>
<i>Prepared by :</i>	Jérôme Luc	Technical Manager	11/23/2021	<i>JS</i>
<i>Checked by :</i>	Jérôme Luc	Technical Manager	11/23/2021	<i>JS</i>
<i>Approved by :</i>	Yann Toutain	Laboratory Director	11/23/2021	<i>Yann Toutain</i>

2021.11.23
 15:06:52
 +01'00'

	<i>Customer Name</i>
<i>Distribution :</i>	Shenzhen STS Test Services Co., Ltd.

<i>Issue</i>	<i>Name</i>	<i>Date</i>	<i>Modifications</i>
A	Jérôme Luc	11/23/2021	Initial release

TABLE OF CONTENTS

1	Introduction.....	4
2	Device Under Test	4
3	Product Description	4
3.1	General Information	4
4	Measurement Method	5
4.1	Liquid Permittivity Measurements	5
5	Measurement Uncertainty	5
5.1	Dielectric Permittivity Measurement	5
6	Calibration Measurement Results	6
6.1	Liquid Permittivity Measurement	6
7	List of Equipment	7

1 INTRODUCTION

This document contains a summary of the suggested methods and requirements set forth by the IEEE 1528 and CEI/IEC 62209 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 32/14 OCPG67
Product Condition (new / used)	Used

A yearly calibration interval is recommended.

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

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



Figure 1 – MVG LIMESAR Dielectric Probe

4 MEASUREMENT METHOD

The IEEE 1528-2003, OET 65 Bulletin C and CEI/IEC 62209-1 & 2 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 (+/-%)
Repeatability (n repeats, mid-band)	4.00%	N	1	1	4.000%
Deviation from reference liquid	5.00%	R	$\sqrt{3}$	1	2.885%
Network analyser-drift, linearity	2.00%	R	$\sqrt{3}$	1	1.152%
Test-port cable variations	0.00%	U	$\sqrt{2}$	1	0.001%
Combined standard uncertainty					5.062%
Expanded uncertainty (confidence level of 95%, $k = 2$)					10.0%

Uncertainty analysis of Conductivity Measurement					
ERROR SOURCES	Uncertainty value (+/-%)	Probability Distribution	Divisor	ci	Standard Uncertainty (+/-%)
Repeatability (n repeats, mid-band)	3.50%	N	1	1	3.500%
Deviation from reference liquid	3.00%	R	$\sqrt{3}$	1	1.730%
Network analyser-drift, linearity	2.00%	R	$\sqrt{3}$	1	1.152%
Test-port cable variations	0.00%	U	$\sqrt{2}$	1	0.001%
Combined standard uncertainty					4.073%
Expanded uncertainty (confidence level of 95%, $k = 2$)					8.2%

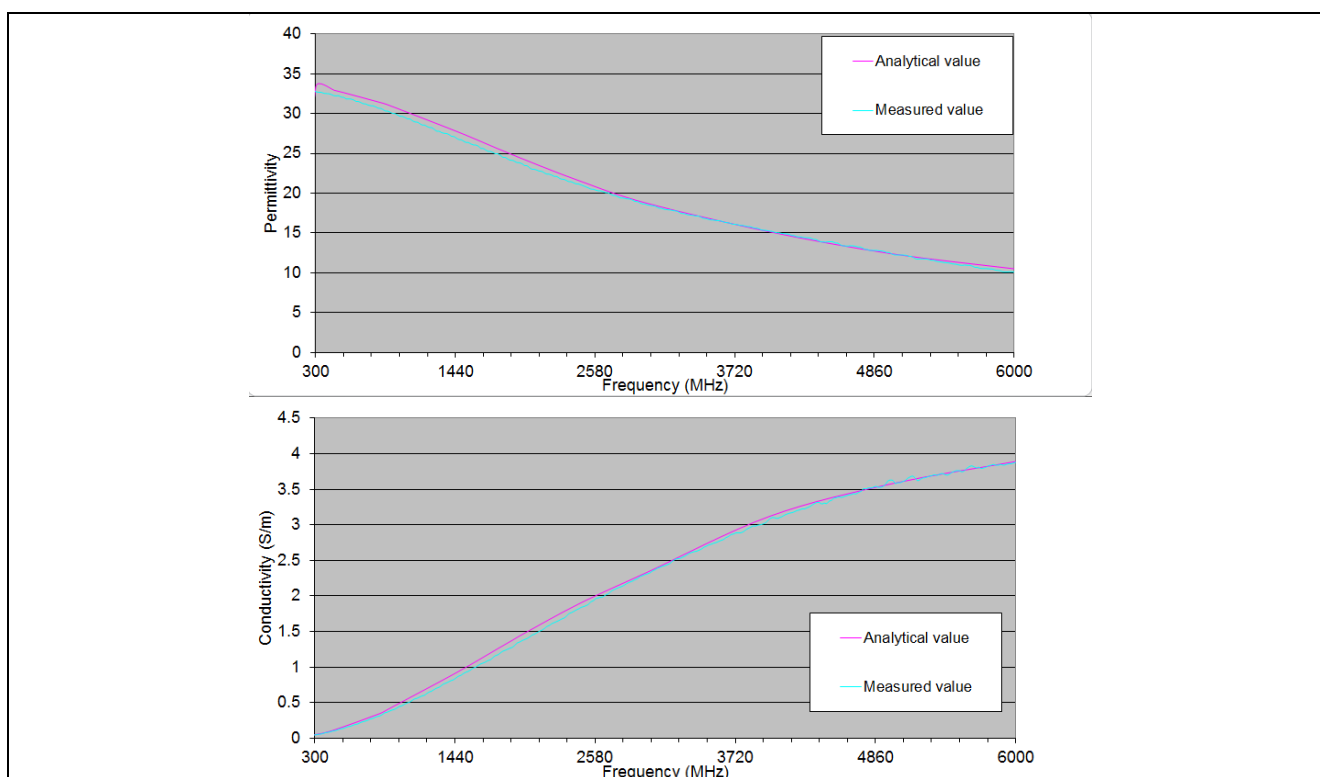
6 CALIBRATION MEASUREMENT RESULTS

Measurement Condition

Software	LIMESAR
Liquid Temperature	21°C
Lab Temperature	21°C
Lab Humidity	44%

6.1 LIQUID PERMITTIVITY MEASUREMENT

A liquid of known characteristics (methanol at 20°C) is measured with the probe and the results (complex permittivity $\epsilon' + j\epsilon''$) are compared with the well-known theoretical values for this liquid.



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.
Network Analyzer	Rhode & Schwarz ZVA	SN100132	02/2019	02/2022
Methanol CAS 67-56-1	Alpha Aesar	Lot D13W011	Validated. No cal required.	Validated. No cal required.
Temperature and Humidity Sensor	Control Company	11-661-9	02/2021	02/2024