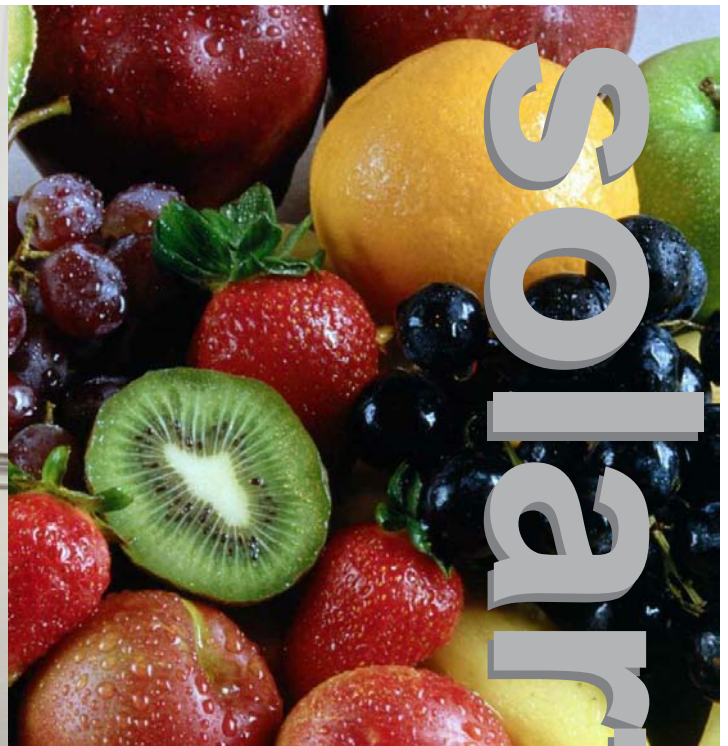


MATERIALS TEST

# 1294 Impedance Interface for biological and bio-medical applications



Solartron

# 1294 - Opening up powerful new techniques for biological and bio-medical investigations



Electrical Bio-impedance is a well-proven, powerful technique for analyzing a wide range of ionic and charge transfer processes in bio-materials (see Applications).

Until now, the use of impedance in bio-material applications has been limited by a number of factors, such as the ability to measure accurately the very low currents involved, and the need for safe working when performing experiments on living tissue.

The new 1294 Impedance Interface has been designed specifically to overcome these difficulties, and to meet the present and future needs of bio-material researchers everywhere.

Used in conjunction with Solartron's 1260 or 1255 frequency response analyzers, the 1294's advanced measurement technology offers:

### Improved accuracy

- ◆ True differential 4-terminal connections minimize the effects of localised disturbances at the current injection points
- ◆ Balanced generator
- ◆ Driven shields

### Safety compliant

- ◆ IEC 601 connections - for in-vivo investigations into a wide range of applications including cosmetics, skin hydration, tissue impedance and tooth decay.

### Wide measurement range

- ◆ 1μV, 1pA sensitivity
- ◆ Impedance range  $10^{-2}$  to  $>10^9\Omega$  ( $>1G\Omega$ ) to cover virtually all bio-materials
- ◆ Up to 750kHz frequency range

### Temperature control

- ◆ 1294 system interfaces with standard temperature controllers

## Applications

Ischemia in tissue, e.g., during organ transplants

Detection and study of tumor tissue and the effects of temperature on tumor growth

Investigation of body fats

Dental research

Gel / electrode studies

Dermatological studies

Blood cell analysis, viral infections

Fruit and food freshness

Growth of plants and trees

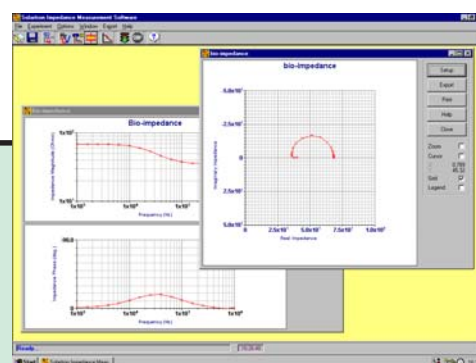
### Impedance measurement

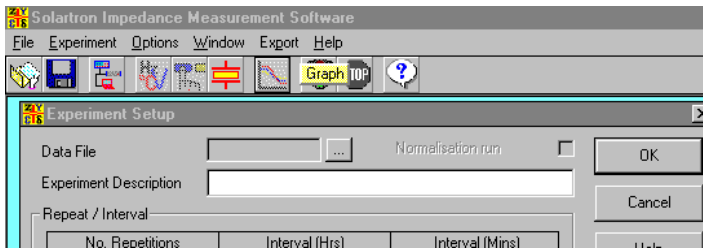
Any material is able to pass current when a voltage is applied to it. If a variable (ac) voltage is applied to the material, the ratio of voltage to current ( $V/I$ ) is known as the impedance. In many materials the impedance varies with the frequency of the applied voltage, in a way that is related to the physical structure of the material, to chemical processes within it, or to a combination of both.

Accurate measurement of the impedance of bio-materials, by applying a low level signal over a wide frequency range, can yield valuable information about the properties of the material. For example, measuring the impedance of a sample of organic tissue - anything from a piece of fruit to a human kidney - can reveal its condition and suitability for storage, freezing or transplant. Teeth can be analyzed to detect cracking or decaying of enamel, or the effects of lotions on skin condition monitored.

Impedance is

- ◆ **non-invasive:** impedance can often be measured with surface electrodes.
- ◆ **non-destructive:** unlike other techniques such as X-rays.
- ◆ **repeatable:** many bio-impedance tests compare the state of tissue over a period of time, or under varying conditions, (e.g. tumor tissue growth). It is essential that the results give a true indication of these changes.





# Specification

## PC control connections

to 1294: Parallel interface  
to FRA: IEEE488 interface

## 1294 measurement connections

to FRA: Gen, V1 Hi, V1 Lo, V2 Hi  
to sample: Normal: 4-terminal connections  
IEC601: 4-terminal connections

## Generator output

Voltage Mode	Normal connections	IEC601 connections
	Max. DC voltage	±10V
Max. AC voltage	7V rms	7V rms*
Max. AC + DC	±10V peak	±10V peak*
Current Mode		
Transconductance	10mA/V	10mA/V*
Max. DC current	±45mA	±10µA*
Max. AC current	30mA rms	10mA rms*
Max. AC + DC	±45mA peak	±14mA peak*

\* subject to IEC601 current limits  
Balanced generator capability in voltage mode only.

## Generator input (from FRA Gen connector)

Rear connection: single BNC  
Max. input voltage: 10V peak from 50Ω source  
Switchable attenuator: x1 / x0.01  
Switchable gain: x1 / x2  
Input impedance: 50Ω for x1  
25kΩ for x2

## Voltage buffers

Driven shield connections to sample  
Amplifier gain: x1  
Common mode range: ±10V  
Bias current: 1nA max  
Input resistance, to ground: >1GΩ  
Input capacitance: 10pF to ground  
Input capacitance: 1pF (differential)

## Voltage buffer output (to FRA V1Hi & V1Lo)

Rear connections: two BNCs  
Maximum output: ±10Vpeak  
Output resistance: 50Ω

## Current to voltage converter

Rear panel Selector	Current range	Resolution	FRA Range	Range Resistor
1V/100mA	30mA	1µA	300mV	10Ω
1v/10mA	3mA	100nA	30mV	100Ω
1V/1mA	300µA	10nA	30mV	1kΩ
1v/100µA	30µA	1nA	30mV	10kΩ
1v/10µA	3µA	100pA	30mV	100kΩ
1v/1µA	300nA	10pA	30mV	1MΩ



## Current to voltage converter output (to FRA V2 Hi)

Rear connection: single BNC  
Maximum output: 300mV rms  
Output resistance: 50Ω

## PC Software

Provides control of FRA, 1294 and optional temperature controller.  
Result parameters: Z\*, Y\*, E\*, M\*, C\*  
Result formats: real, imaginary, magnitude, phase, tanδ  
plotted vs: frequency, time, temperature, bias, ac level  
plotted on: Bode, complex plane

## General

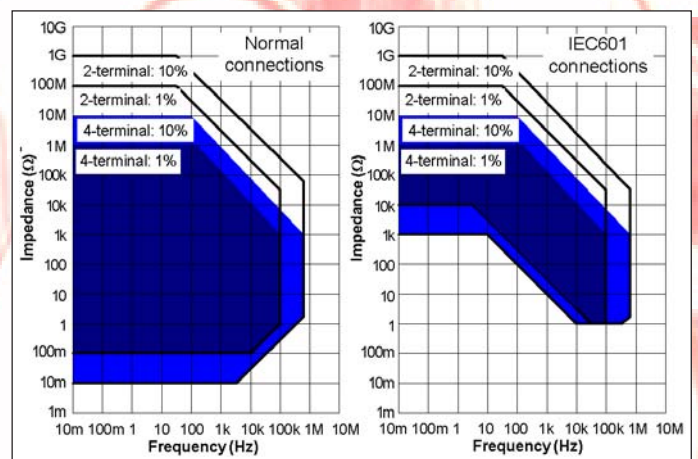
Power supply: 90Vac to 264Vac (47Hz to 440Hz)  
Power consumption: 18W  
Weight: 6.5kg (14.5 lb)  
Operating temperature: 5° to 40°C (40° to 104°F)  
General safety: EN61010  
Medical safety: IEC601, EN60601-1 (Power supply: 47 to 65Hz)

## Medical safety

Passive circuits in the drive and sense lines of the IEC601 connections protect live subjects from excess current in accordance with the IEC601 standard.

## 1294 Typical measurement accuracy

4-terminal measurements assume simulated electrode impedance of 10x sample impedance.





## System Requirements

Frequency response analyser:	1260, 1255, 1250 or 1253
Minimum PC requirements:	IBM compatible 486DX running Microsoft Windows™ 3.1, 95, NT4 8 Mbyte RAM, hard disk, mouse VGA display ISA or PCMCIA expansion slot Parallel Printer Port (for control of 1294)
IEEE488 interface card:	National Instruments PCI-GPIB card or National Instruments PCMCIA or National Instruments USB-GPIB Controller cable
<b>Options:</b>	
Temperature controller:	Oxford Instruments ITC503 or Lakeshore 340

Solartron has been a market leader in supplying precision measurement solutions for research and manufacturing in the oil, gas, power, aerospace and process industries for 50 years.

Solartron manufactures a range of laboratory instrumentation specifically for electrochemistry and materials characterization which, together with our data acquisition and density and viscosity transducer products, have a global reputation for excellence in performance, reliability and support.

## Ordering Information

**1294A** 1294A Impedance Interface includes 129601S software, user manual, power cord, test module, parallel interface cable

### Connection cables (included)

- 12942A** IEC601 connection cables
- 12942B** Normal connection cables



Solartron Analytical's Quality System is approved to BS EN ISO 9001:1994



**FM01709**

...part of **AMETEK**® Advanced Measurement Technology

Unit B1 Armstrong Mall  
Southwood Business Park  
Farnborough GU14 0NR  
United Kingdom  
Tel: +44 (0) 1252 556 800  
Fax: +44 (0) 1252 556 899

801 South Illinois Avenue  
Oak Ridge  
TN 37831  
USA  
Tel: (1) 865-425-1360  
Fax: (1) 865-425-2410

[solartron.info@ametek.com](mailto:solartron.info@ametek.com)

[www.solartronanalytical.com](http://www.solartronanalytical.com)