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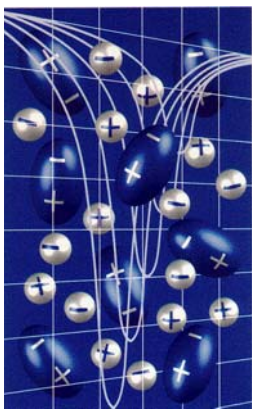
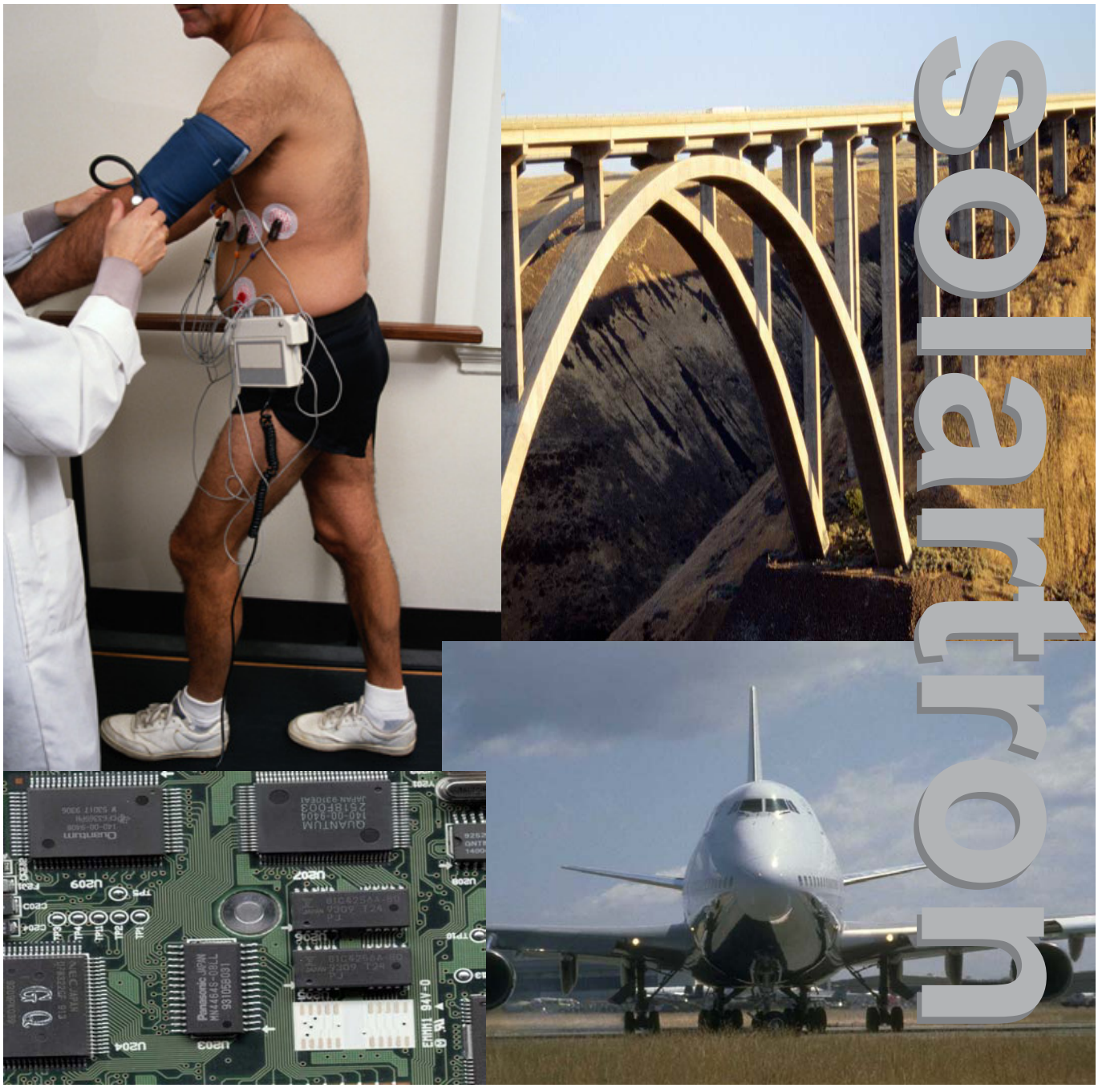


MATERIALS TEST

# 1294 Impedance Interface



# 1294 - Opening up powerful new techniques for materials investigation

Electrical impedance is a well-proven, powerful technique for analyzing the physical and chemical properties of a wide range of materials (see Applications).

Until now, use of the technique with high impedance, low loss materials has been limited by a number of factors, such as the ability to measure accurately the very low currents involved, particularly when high electrode impedances are present.

The new 1294 Impedance Interface has been designed specifically to overcome these difficulties, and to meet the present and future needs of materials analysts 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 $>10^{9}\Omega$ (>1GΩ) to cover virtually all materials
- Up to 750kHz frequency range

***Temperature control***

- 1294 system interfaces with standard temperature controllers, cryostats and furnaces

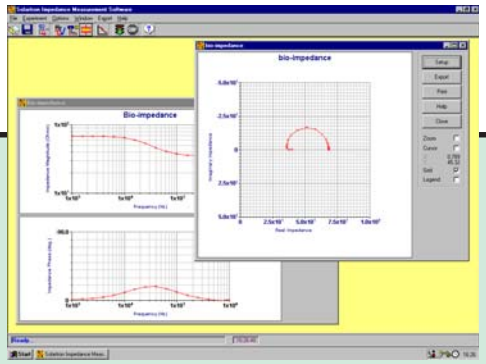
## Applications

**Civil Engineering**
*- Cement paste research*
*- Content/strength of concrete mixes*

**Adhesives**
*- Epoxy resin curing*
*- Thermoset polymers*

**Biomaterials**
*- Ischemia and tumour research*
*- Tooth decay*
*- Dermatological studies*
*- Research in fruit and plants*

**Ceramics/Composites**
*- Gas sensors*
*- Gas separation membranes*



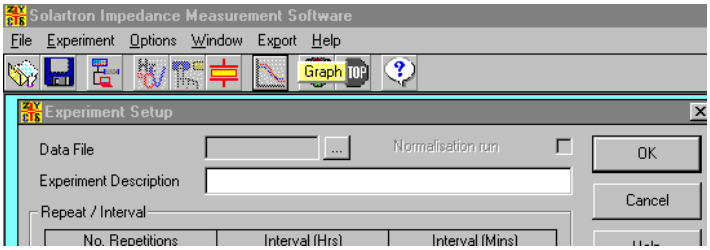

**Impedance measurement**

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 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. Samples of concrete or cement can be analyzed to predict strength, or water/cement/binder mix, and complex curing cycles for composite structures such as aircraft wings can be monitored and controlled.

Impedance is

- **non-invasive:** impedance can often be measured with surface electrodes.
- **non-destructive:** low level stimuli required typically have no (or minimal) effect on material being investigated.
- **repeatable:** many impedance tests compare the state of a material over a period of time, or under varying conditions, e.g. adhesive curing. Consistent measurements are essential for 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 | ±10V* |
| Max. AC voltage | 7V rms | 7V rms* |
| Max. AC + DC | ±10V peak | ±10V peak* |
| **Current Mode** | | |
| | Normal connections | IEC601 connections |
| 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<br>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<br>3mA | 1µA<br>100nA | 300mV<br>30mV | 10Ω |
| 1v/10mA | 300µA | 10nA | 30mV | 100Ω |
| 1V/1mA | 30µA | 1nA | 30mV | 1kΩ |
| 1v/100µA | 3µA | 100pA | 30mV | 10kΩ |
| 1v/10µA | 300nA | 10pA | 30mV | 100kΩ |
| 1v/1µA | 30nA | 1pA | 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**

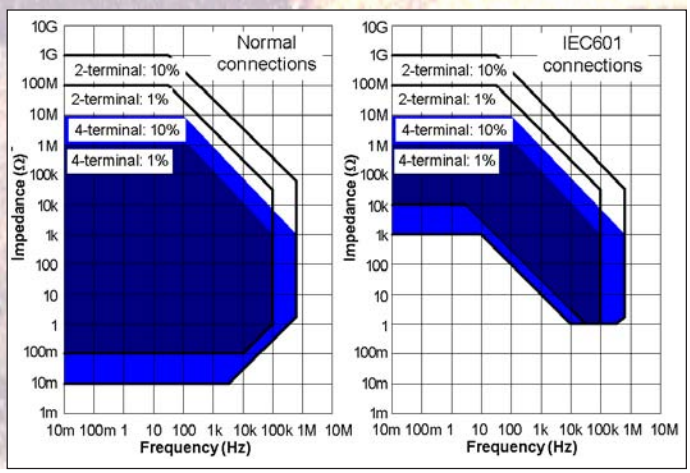
| | |
|---|---|
| Power supply: | 90Vac to 264Vac (47Hz to 440Hz) |
| Power consumption: | 18W |
| Weight: | 6.5kg (14.5 b) |
| Operating temperature: | 5° to 40°C (40° to 104°F) |
| General safety: | EN61010 |
| Medical safety: | IEC601, EN60601-1 (Power supply: 47 to 65Hz) |

**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.

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## 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<br>ISA or PCMCIA expansion slot |
| | Parallel Printer Port (for control of 1294) |
| IEEE488 interface card: | National Instruments PCI-GPIB card or<br>National Instruments PCMCIA or<br>National Instruments USB-GPIB<br>Controller cable |

**Options:**

| | |
|---|---|
| Temperature controller: | Oxford Instruments ITC503 or<br>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

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Solartron Analytical's Quality System is approved to BS EN ISO 9001:2008

BSI UKAS QUALITY MANAGEMENT 003

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