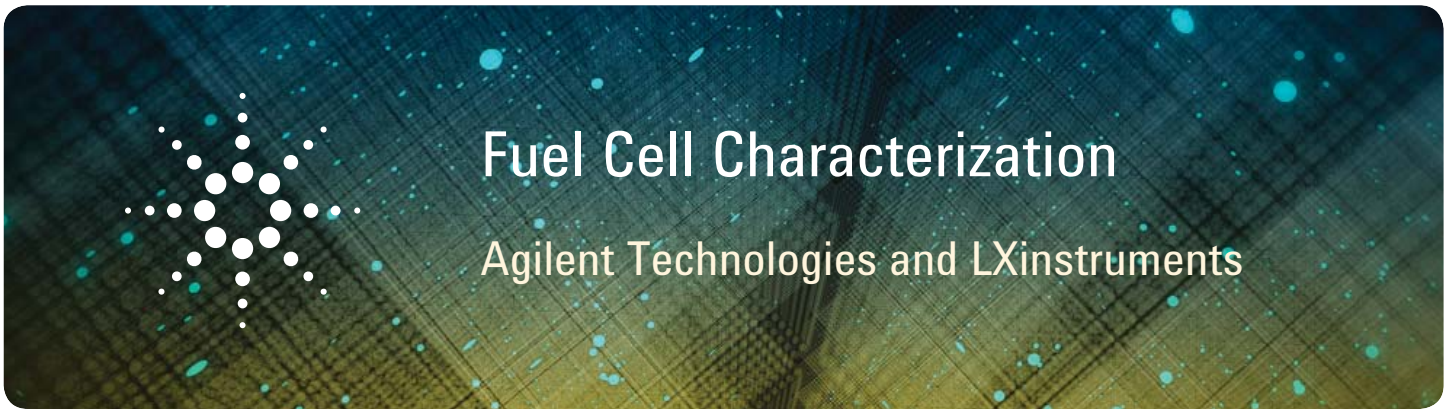


Fuel Cell Characterization

Agilent Technologies and LXinstruments

Modular, multi-channel characterization of stacked and segmented fuel cells

Research into the development of fuel cell technologies requires exhaustive characterization of devices in both stacked and segmented configurations using Electrochemical Impedance Spectroscopy.

In a stacked configuration multiple fuel cells are connected in series and measurements are made across each cell. In a segmented configuration the fuels cells are connected to a common anode and then measurements are made at each cathode in turn.

The characterization of both of these configurations requires multi-channel measurements to be made under variable loads and under controlled environmental and gas conditions.

LXinstruments

Agilent Technologies

Solutions Partner

The LXinstruments Fuel Cell Test System uses the Agilent L4534A LXI Digitizer with four differential floating inputs to provide the multi-channel measurement capability required. The LXI Digitizers provide 20 MHz simultaneous acquisition with floating AC coupled measurements for increased resolution. Agilent's N3302A Electronic Loads, modulated with the Agilent 33220A Function/Arbitrary Waveform Generator, are used to provide synchronized, variable load conditions.

The system is controlled by a personal computer that includes a software implementation of a lock-in amplifier. The Lock-In Algorithm allows accurate measurement of frequency and phase and eliminates the need for a hardware-based implementation using DSP. The LXI connectivity provided by the L4534A digitizers allows communication between the system and the controlling PC over an industry standard GBit LAN. This supports the fast transfer of the large blocks of data necessary to calculate the frequency and phase response of the individual cells.

The LXinstruments Fuel Cell Test System uses standard equipment from Agilent Technologies together with proprietary software to provide a fully modular and affordable system for making EIS measurements allowing you to characterize your fuel cell designs in both stacked and segmented configurations.

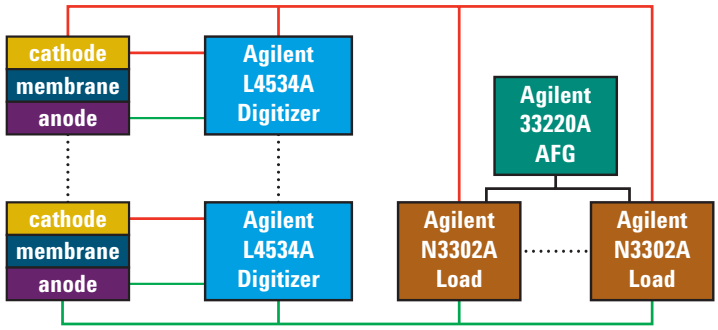
Electrochemical Impedance Spectroscopy

Fuel cells, in common with other electrochemical cells, exhibit complex impedance characteristics that result in a non-linear voltage/current relationship. In order to measure electrochemical impedance an AC current is applied to the cell and the resulting voltage is measured. The response is an AC voltage signal that is out of phase with the applied current. To ensure that the cell's response is pseudo-linear a small input signal is used that constrains the output range to the linear portion of the curve.

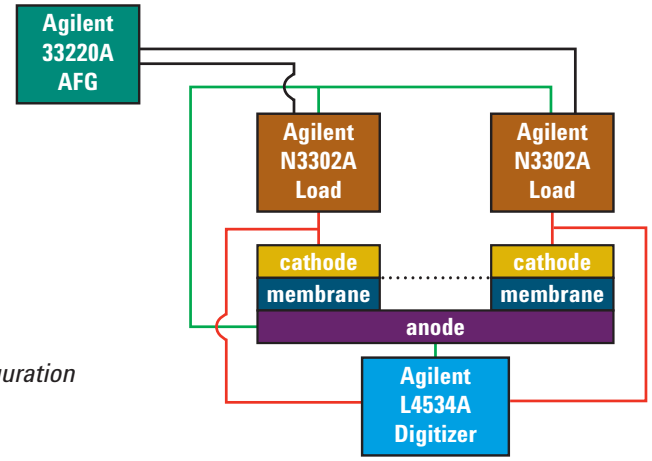
The analysis of the response requires frequency and phase components to be extracted. This is commonly undertaken using Fast Fourier Transforms or a Lock-in Amplifier and is displayed with Nyquist Plots. EIS measurements have traditionally required specialized test equipment that is high cost and limited in channel count. The LXinstruments Fuel Cell Test System overcomes this by utilizing commercial off-the-shelf test equipment and a software implementation of a Lock-in Amplifier.

Agilent Technologies

Fuel Cell Characterization



Fuel Cell in Stacked Configuration



Fuel Cell in Segmented Configuration

Ordering Information

Agilent Technologies

L4534A	4 CH, 20 MSa/s Digitizer
N3300A	Electronic Load Mainframe
N3302A	Electronic Load
33220A	Arbitrary Function Generator

LXinstruments

System Design & Engineering Services

- Customized Fuel Cell Test System with 19" Rack, integrated Industrial PC and internal wiring
- Customized Fuel Cell Test Software (functionality based on customer requirements)
- On site installation Customer Education and Uptime Support Services

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For more information on Agilent Technologies' products, applications or services, please contact your local Agilent office. The complete list is available at:
www.agilent.com/find/contactus.

www.agilent.com/find/lxi

Agilent is co-founder of the LXI Consortium. For specifications visit the LXI Consortium web site at
www.LXIstandard.org

LXinstruments

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LXI
LAN eXtensions for instrumentation

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