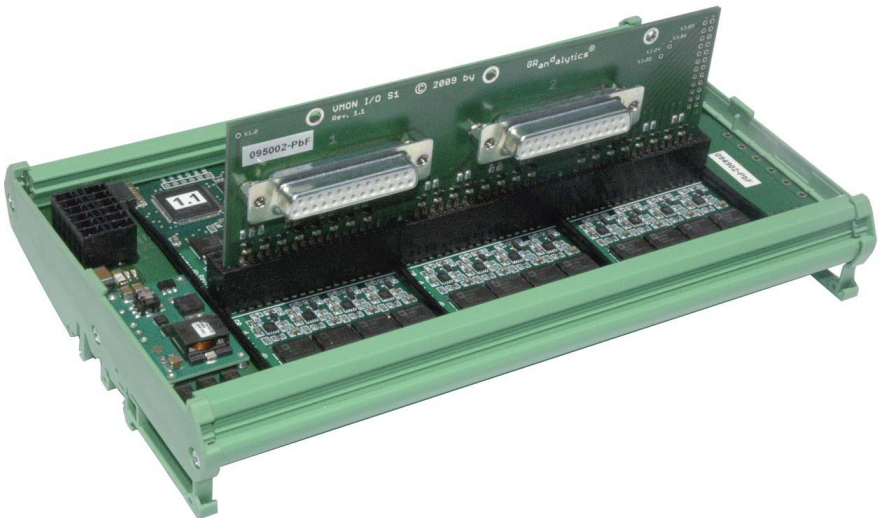


Multichannel Impedance Spectrometry Tool

**A highly cost effective measurement system
for
fuel cell stacks, batteries, and PV arrays**



- **16-channel-modules, up to 240 channels total**
- **8-channel-modules with signal conditioning**
- **channel-to-channel isolation**
- **true simultaneous sampling**
- **custom made connection plug-in board**
- **SW and HW Trigger, standard SPI readout**
- **connects to computer/PLC/μP**

The expandable voltage monitoring system is a low cost, modular, fully isolated, simultaneously sampling data acquisition system, specifically built for fuel cell stacks and battery testing. Its modular design allows for stacking up to 15 modules with 16 channels each, resulting in a total of 240 channel. A trigger (SW or HW) starts the simultaneous acquisition of all individual A/D converters. Data are buffered and read out sequentially via SPI. The connection board is made-to-order to plug in the stack sensing lines without additional cable adapters.

To acquire physical properties, 8-channel modules with plug-in signal conditioning sub-boards can be added for temperature probes (TC, RTD), industrial current loop sensors (4-20mA), increased voltage range, and more. Signal conditioning plug-ins can be mixed on a per-channel base to build the exact system needed. Custom specific plug-ins are also possible.

The standard packaging is a DIN-rail mount, as depict on page 1. If a more compact design is required (e.g., in-vehicle measurements), an aluminum enclosure is available.

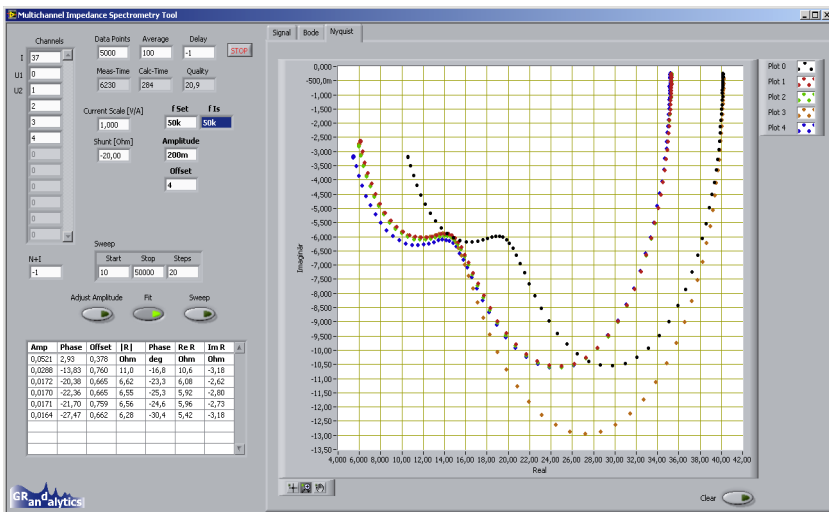
Specifications:

- Channel-to-channel galvanic isolation > 300V
- Interface-to-measurement galvanic isolation > 1000V
- Native measurement range 0 to 1.25V/2.5V
- Standard and custom signal conditioning sub-board
- 12 bit/16 bit resolution (16/8 channel boards)
- Simultaneous acquisition of all channels
- Industrial standard SPI interface (5V/3.3V TTL/CMOS)
- Hardware and software trigger
- Trigger accuracy < 1us (HW trigger → start sampling)
- Readout time 200 μ s+24 μ s/channel (~1ms/32channels)
- IS frequency 50mHz to 50kHz (wider range possible)
- Supply voltage 9-36V, about 2.5W/module
- Industrial standard DIN mounting or custom enclosure
- Custom plug-in board connects directly to UUT

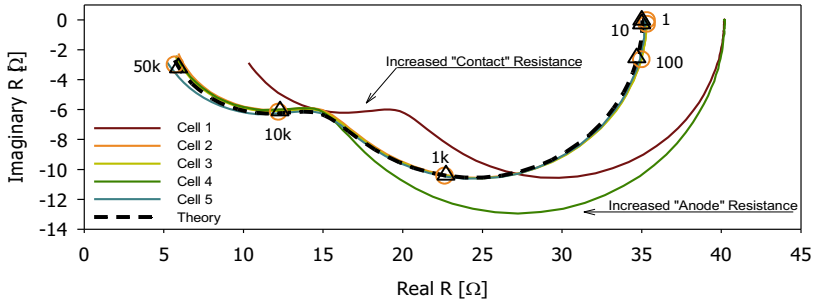
For standard voltage monitoring or even propagation distribution analysis within the stack, the SPI interface can be connected to a USB-adaptor, a National Instruments Compact-RIO, PC, PXI or any micro-controller that supports industrial standard SPI. A suite of LabVIEW VIs and ready-to-run example code is provided, detailed timing charts and specifications help to easily create applications on other platforms.

Impedance spectrometry is more demanding, hence a Compact-RIO, PXI or equivalent is recommended. A versatile user interface (see below) is provided to allow basic diagnosis, single point and sweep tests. Any custom analysis and algorithm can be added to the open-source GUI code.

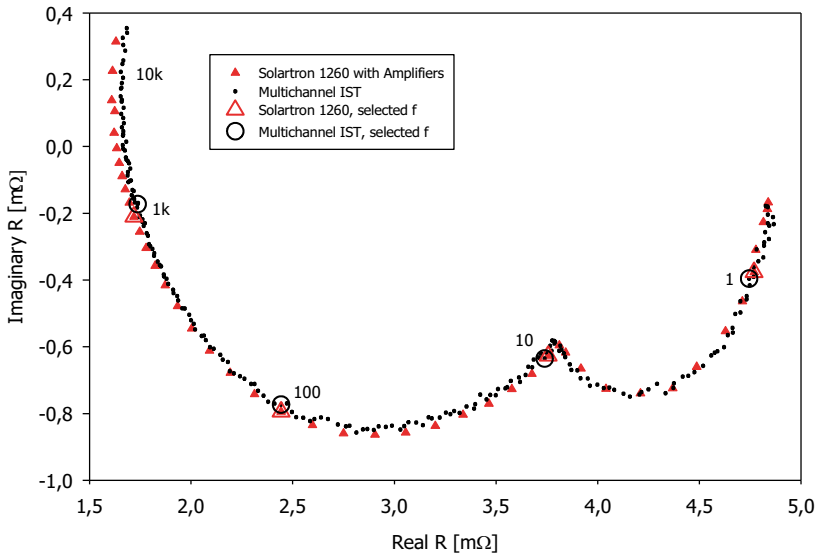
This system is also very well suited to upgrade existing laboratory test stations or for quality inspection in production lines. The small footprint and easy integration makes it even attractive for monitoring deployed stacks in the field. Adding high-end diagnosis capabilities at low-end cost is a new way to assure performance and detect cell failure early.



Open-source user interface (optional) for embedding or customized analysis



Measurement of R/C-stack-dummy with 2 faults to compare data with theory



Reference measurement with high-end Solartron EIS on a single fuel cell

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