MCM INTELLIPROBE U02 AC

MULTI-CHANNEL HIGH-VOLTAGE MEASUREMENT TECHNOLOGY IN ELECTROCHEMICAL IMPEDANCE SPECTROSCOPY (EIS)

Application example

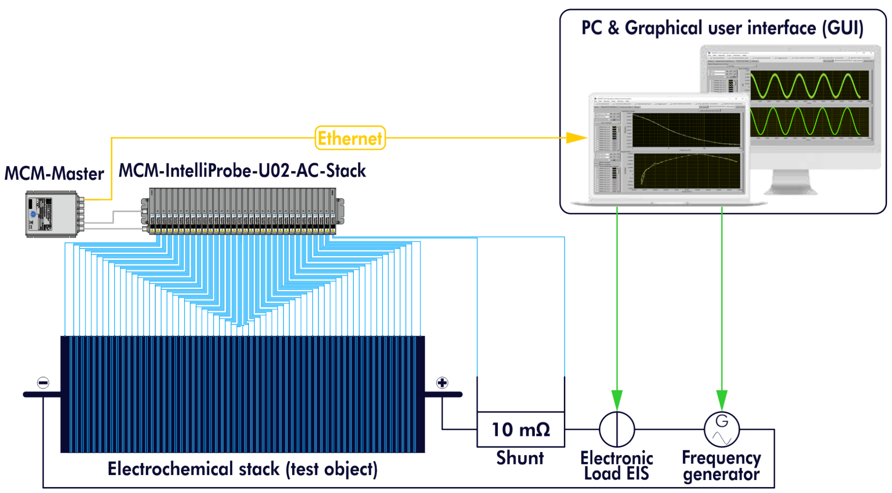
As part of the "FullStack TS" research project, SMART TESTOLUTIONS, together with its partners MS2 Engineering & Anlagenbau GmbH and the Fraunhofer Institute for Solar Energy Systems (ISE), has developed a test bench for fuel cell full stacks with an output of up to 200 kW. The test bench is designed to meet the requirements for full stacks, with a particular focus on applications in trucks, trains, and aviation. The aim was to be able to analyze even complex electrochemical processes in real time.
The MCM IntelliProbe U02AC module from SMART TESTSOLUTIONS enables precise AC voltage measurement in the individual cells of the electrochemical cell stack as part of electrochemical impedance spectroscopy in this test bench. This is particularly useful for multi-channel parallel measurement for faster measurement cycles.

Role of the module in the test bench

The U02 AC is part of the modular measurement system for electrochemical impedance spectroscopy (EIS) in the test bench. It measures the AC voltage response of individual cells to sinusoidal current excitations. By connecting several modules in series, multi-channel, time-synchronous signal acquisition is achieved. The signals are sent to a master module, which transfers the data stream via Ethernet to a PC for impedance calculation. The assembly is housed in a climate chamber, which allows for very short cables.

How the EIS system works

Electrochemical impedance spectroscopy measures the alternating current resistance (impedance) of a fuel cell as a function of frequency. A sinusoidal current is superimposed on the fuel cell stack while the voltage response of each individual cell is recorded. By varying the frequency, different physical and chemical processes can be specifically investigated, such as membrane moisture or degradation mechanisms.



EIS structure

- U02AC measurement module stack: Each module has two galvanically isolated measurement channels.
- MASTER module: Used for real-time data processing and communication via CAN bus and Ethernet.
- Electronic load: Generates the sinusoidal excitation for impedance measurement. Must provide high dynamics and power up to 30 kW.
- Frequency generator: Specifies the frequency and current amplitude for the measurement.
- EIS software on the test bench PC: Calculates the impedances from the measured values.
- Graphical user interface on the PC: Used for configuration and visualization of the measurement data.

SMART TESTSOLUTIONS

Technical Data	MCM IP U02 AC
Dimensions per module (LxWxH)	108 x 105 x 30 mm
Number of channels	2 individually galvanically isola-ted channels
Form factor	compact, stackable, IP54
Supply voltage	selectable range 7 to 36 V
Measuring ranges AC/DC (switchable)	+/- 100, +/- 50, +/- 20, +/- 10, +/- 5 mV optional: +/- 2, +/- 1 mV
DC measuring range	+/- 5 V
Amplitude resolution	16 bits
Permanent channel isolation	1.000 V
Overvoltage resistance	5000 Vms (1min)
Frequency range	0,1 Hz to 1 kHz
Measurement data transfer	CAN and RS485
I/O signals	Clock I/O, Trigger IN, Trigger OUT 1&2, Error OUT
Ambient temperature range	- 40 to +105 °C

The MCM IntelliProbe product family

The U02AII AC voltage measurement module is part of the MCM IntelliProbe product family. A special feature are the two galvanically isolated voltage measurement channels, which are well protected against interference by steep-edged filters. The high-voltage isolation and temperature capability allow direct operation on the test object, even in a climate chamber.

The form factor of the U02 AC and the IntelliProbe U10 fuel cell voltage measurement module is largely identical. Both are housed in a plastic enclosure. Up to 60 of the modules can be connected together to form a stack. These measurement stacks are completed by a link module and a termination module.

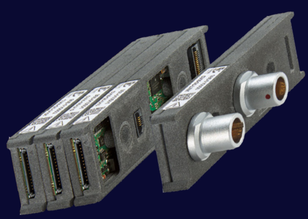
Other members of the family include the MASTER module and its variant without IP protection, SlimMaster, which was also used in the "FullStack TS" test bench. These process modules enable local data processing and high-speed data connection to a PC via Ethernet and additional bus interfaces (CAN, GPIO).

Order information

The following MCM components are part of the electro-chemical cell impedance measurement implemented in the practical example:

- 1 - 60 MCM-IntelliProbe U02 AC measurement modu-les, item no. 966-070260, 1 U02T AC, item no. 966-070220
- 1 x IntelliProbe Link Module V3, item no. 986-010500
- 1 x IntelliProbe Link Module V4, item no. 986-010516
- MCM SLIM Master as Ethernet-Interface, item no. 986-010508

- **MULTI-CHANNEL, PARALLEL, AND FULLY SYNCHRONOUS AC VOLTAGE MEASUREMENT**
- **COMPACT, GALVANICALLY ISOLATED MEASURING HEADS**
- **LOW MEASUREMENT COSTS**
- **PRECISE MEASUREMENT EVEN IN HARSH ENVIRONMENTS**



MCM-IntelliProbe U02 AC voltage measurement modules with link module