

MT-LAB

Integrated solution for Materials Characterization under wide temperature range and controlled atmospheres



 **BioLogic**

APPLICATIONS

- Ceramics
- Solid oxides
- Polymers
- Rubbers
- Dielectrics
- Composites
- Solar/photovoltaic cells
- Semiconductors
- Biological cells
- Liquids
- Electronic components



MTZ-35

Redefining value in impedance analyzers.

This easy-to-use impedance analyzer, delivered with its high performance software **MT-Lab**, is the new standard for impedance measurements.

A global leader in scientific instrumentation for materials science and engineering, Bio-Logic proposes an integrated solution for electrical characterization of materials. The solution includes the MTZ-35 impedance analyzer, temperature and control units and simple holders. Combining our world class design and manufacturing with the latest measurement technology on the market today, the **MTZ-35** system is the value choice without sacrificing performance.

A modern materials science lab faces challenging measurements each day, and impedance spectroscopy is a primary tool in materials research that helps characterize the physical properties and/or chemical interactions of the materials under investigation.

The Bio-Logic **MTZ-35** impedance analyzer has the specifications and features required to address the broad scope of applications in the materials research field. With a wide frequency range (10 μ Hz - 35 MHz) and superior accuracy (0.1% amplitude, 0.05% phase) the **MTZ-35** impedance analyzer tackles the most difficult tasks in materials science today.

Exploring new frontiers of impedance testing with a wide frequency range impedance analyzer and a full range of ancillary equipment.

MEASUREMENT RANGES

- Frequency 10 μ Hz to 35 MHz
- Inductance 10 nH to 10 kH
- Capacitance 1 pF to 1000 μ F
- Resistance 1 m Ω to 500 M Ω

ANCILLARY EQUIPMENT

- High Temperature Furnace (HTF-1100)
- Intermediate Temperature System (ITS)
- High Temperature Sample Holder (HTSH-1100)
- Controlled Environment Sample Holder (CESH)
- High Temperature Conductivity Cell (HTCC)

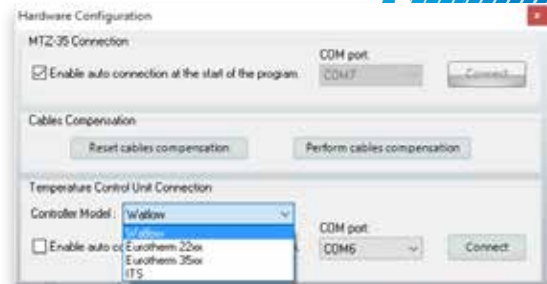
MT-Lab[®], complete and powerful interface

MT-Lab is an intuitive software used for the control of MTZ-35. It also allows the control of many temperature control units:

- High temperature furnace (HTF-1100)
- Intermediate Temperature System (ITS)
- Temperature control systems using Eurotherm 22xx and 35xx series controllers

Open circuit / Short circuit Compensation

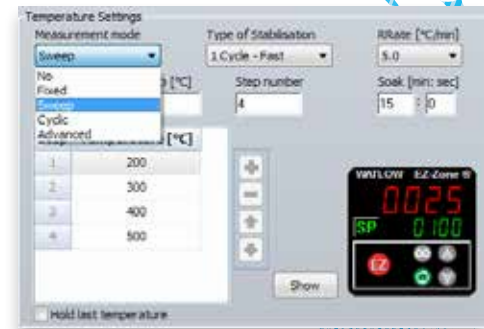
MT-Lab software is provided with a compensation protocol for the compensation of residual impedance due to cell cables and test fixtures.



Temperature management

Temperature Control management

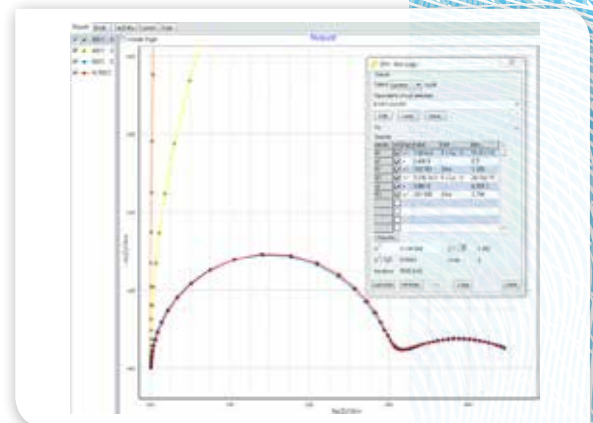
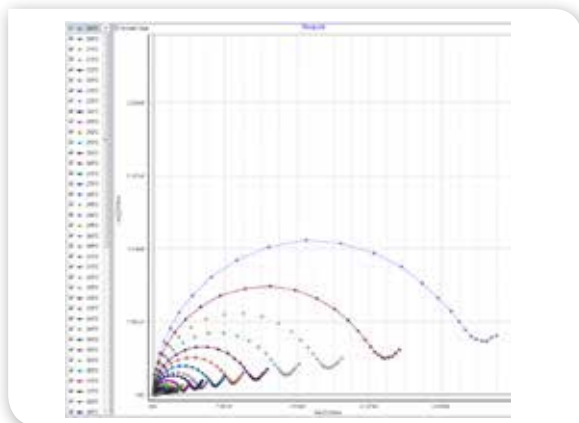
Five control temperature modes are available with MT-Lab. The software offers a wide range of heating rates and two temperature stabilization modes (fast and precise) based on closed-loop temperature regulation. Temperature control is optimized. Setpoint temperatures are reachable and adjustable without overshoot.



MT-Lab graphics

A complete graphic package

MT-Lab is a very easy to use software. The setting and the graph are displayable on one screen view. The software includes numerous graphic tools and advanced tools for equivalent circuit modeling (Z Fit). Users can build their own circuit model using a range of 13 electrical elements (R,C,L, Q, La, W, Wd,M,Ma,Mg, G,Ga).



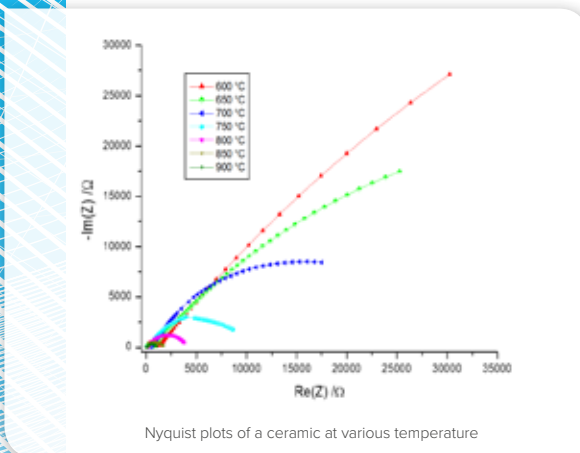
Temperature Control Units

High Temperature Furnace

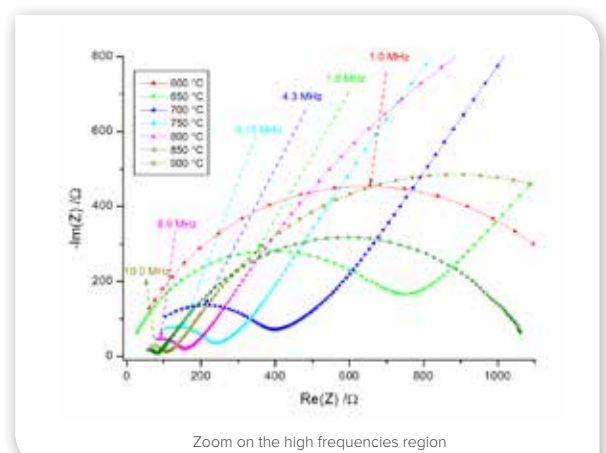
High Temperature Furnace (HTF-1100) is a horizontal laboratory tube furnace dedicated to characterization of **materials properties** and to **heat treatments** in the temperature range between the ambient and 1100 °C.

The HTF-1100 is designed to accommodate Bio-Logic High Temperature Sample Holder HTSH-1100. A **k-type thermocouple** placed in the bottom of the furnace ensures an accurate control and measurement of the furnace temperature.

The HTSH-1100 is provided with a programmable **Watlow controller** accessible on the front panel of the furnace. It offers an easy way to **set and monitor the furnace temperature** during a test. For user safety, an emergency stop button was wired to interrupt power to the heating element of the furnace in the case of an unexpected event. HTF-1100 is provided with a temperature limit alarm (buzzer) to help prevent overheating.



Nyquist plots of a ceramic at various temperature



Zoom on the high frequencies region

Software

The HTF-1100 furnace is controllable by MT-Lab software through **MTZ-35 Impedance analyzer**. It can also be controlled manually using the Watlow controller panel.

MT-Lab software offers an intelligent temperature management with various temperature control modes (fixed temperature, sweep, cyclic, advanced mode) and various temperature rates (from **0.1 to 20 °C/min**) and dwell times.

SPECIFICATIONS

Temperature range	ambient to 1100 °C
Temperature scan	adjustable from 0.1 °C/min to 20 °C/min
Temperature accuracy	better than ±1 °C
Computer Interface	RS-232 through MTZ-35
Mains voltage	220-240 V 50/60 Hz
Power consumption	1200 W
Heating chamber dimension	50 x 200 mm (W x D)
Heating system	super kanthal 1350 °C wire built in a cement cylinder
Temperature controller	PM6 Watlow controller
Insulation material	fiber alumina
Safety features	emergency stop button, buzzer sound alarm & temperature safety limit
Dimension	545 x 331 x 266 mm (L x W x H) with slide
Weight	13 kg

Compatible with

- HTSH-1100
- MTZ-35

Intermediate Temperature System

The **Intermediate Temperature System (ITS)** is a temperature control unit based on **Peltier** effect.

The ITS is a compact temperature chamber with a small footprint. It enables accurate temperature control from **-35 °C to +150 °C**.

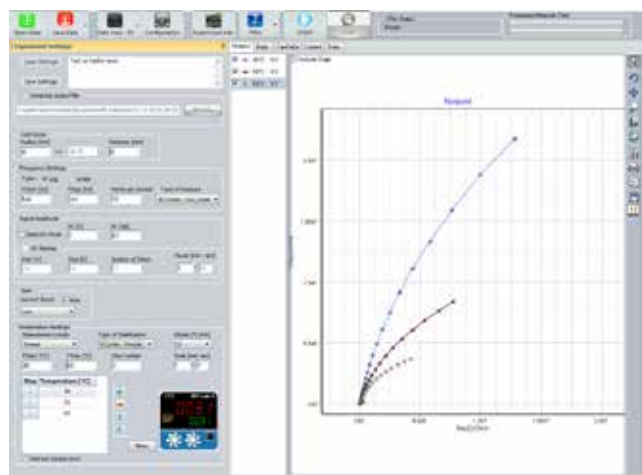
The ITS is designed to accommodate Bio-Logic sample holders such as leak tight sample holders (CESH). The two PT-1000 temperature probes provided with the ITS ensure an accurate measurement and control of the temperature. An optional PT-1000 probe is proposed for a direct measurement of the actual temperature of the sample.

The ITS is suited for the characterization of materials properties by impedance measurements under controlled temperature. It was adapted for a use in controlled atmosphere (up to 2 bar relative pressure) with CESH option.



CESH inside ITS Chamber

The sample can be prepared in a glove box, placed in the CESH and then installed in the ITS. The ITS is compatible with MTZ-35 impedance analyzer and with Bio-Logic potentiostats/galvanostats/FRA. This allows Bio-Logic system owners to easily setup their own experiments.



Evolution of impedance with temperature

SPECIFICATIONS

Temperature range	-35 °C to +150 °C
Temperature accuracy	±0.3 °C
Computer Interface	USB 2.0
Mains voltage	115 V/230 V 50/60 Hz
Power consumption	250 W
Dimension	400 x 313 x 385 mm (L x W x H)
Weight	8 kg

Software

The ITS is controlled through USB connection using MT-Lab software.

The ITS can be also controlled by EC-Lab software using Auxiliary inputs/output of Bio-Logic potentiostat.

MT-Lab and EC-Lab interface provide protocols and data graphing for impedance measurement and data processing. The impedance data can be fitted using the powerful Z Fit EIS modeling software.

The full system includes:

- The ITS
- A leak tight CESH
- Two PT-1000 probes

Compatible with:

- Third PT-1000 probe
- MTZ-35 impedance analyzer or Bio-Logic potentiostat

Sample Holders

High Temperature Sample Holder

High Temperature Sample Holder (HTSH-1100) is a test fixture dedicated to characterization of electrical properties of solid materials using the parallel plate capacitor method over the temperature range between the room temperature and 1100 °C. HTSH-1100 can also be used for heat treatment in controlled atmospheres.

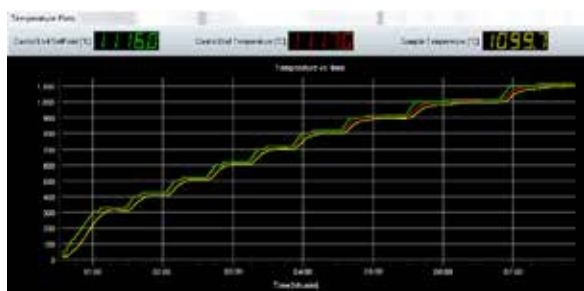
The HTSH-1100 is compatible with the Bio-Logic High Temperature Furnace HTF-1100 and other tubular furnaces with a minimal worktube diameter of 46 mm. A k-type thermocouple placed closely to the sample ensures an accurate measurement of the temperature close to the sample.

The HTSH-1100 can operate under controlled environment conditions with inert gas or active gas (Ar₂, N₂, O₂, etc.) and with variable pressures up to 2 bar relative. A quartz tube is supplied with the HTSH-1100 for performing measurements under controlled atmospheres. The HTSH-1100 base is fitted with a gas inlet/outlet for gas flow. A safety valve rated at 30 PSI limits the internal gas pressure to 2 bar.

It also allows gas to escape when the internal pressure increases with temperature and exceeds 2 bar.



Sample Holders	Operating Temperature	Features	Compatibility	
HTSH-1100	Ambient to 1100°C	Quartz tube for controlled atmosphere Leak-tight up to 2 bar relative K-type thermocouple	HTF-1100 & Tubular furnaces	
				Φ=25 mm
				Φ=12 mm
				Φ=06 mm
Φ=03 mm				



Temperature plots

Software

MT-Lab software interface allows user to set geometric factor of the cell (diameter, thickness) for the cell constant calculation and so the calculation of the electrical conductivity from raw impedance data. MT-Lab software allows also compensation of residual and stray impedance with MTZ-35.

SPECIFICATIONS

Temperature range	from RT to 1100°C
Electrodes	High purity Platinum disc (1 mm thickness)
Electrode diameter	3 mm, 6 mm, 12 mm or 25 mm
Temperature accuracy	±1 °C
Maximum sample diameter/thickness	27 mm // 5 mm
Quartz tube dimension	270.5 x 45.5 mm
Temperature probe	Inconel shielded K-Type thermocouple
Dimension with quartz tube	310.5 x 80.0 mm
Weight	1.2 kg

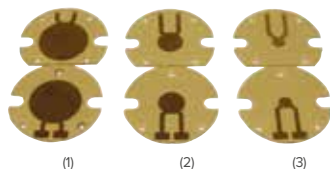
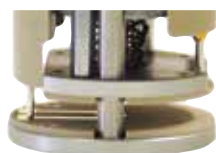
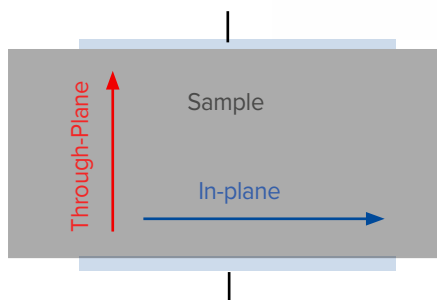
Compatible with:

- HTF-1100
- MTZ-35

Controlled Environment Sample Holder

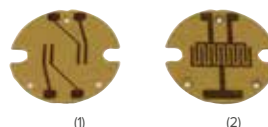
The **Controlled Environment Sample Holder (CESH)** is a parallel plate sample holder dedicated to electrical characterization of flat material samples in the temperature range between -40 and 150 °C.

The CESH comes in two models: **In-plane** CESH and **Through-plane** CESH. The “Through-plane” model is dedicated to measurement of an electrical parameter in a direction perpendicular to that of the plane of the sample while the “In-plane” model is more dedicated to measurement of electrical parameter in a direction parallel to that of the plane of sample.



Through-plane

- 1 inch ⁽¹⁾
- 1/2 inch ⁽²⁾
- 1/4 inch ⁽³⁾



In-plane

- a standard electrode set ⁽¹⁾
- an interdigitated electrode set ⁽²⁾



Many materials are anisotropic, such that the conductivity (or other electrical property) in the through-plane direction is different from that of the in-plane direction. This is why both CESH models are needed for a complete characterization of a material. The CESH can be handled in a glove box and placed in an Intermediate Temperature System (ITS) or in another temperature chamber.

Each CESH is equipped with a gas inlet/outlet for material testing in continuous flow mode or in static mode. It is leak-tight up to 2 bar relative. The CESH is offered with 4 cell cables (1.0 m) for connection to MTZ-35 and 4 cell cables (18 cm) for connection to a Bio-logic potentiostat. The CESH is provided with four SMB connectors for 4-point measurements. It can also be used to perform 2-point measurements using MTZ-35 or a Bio-Logic potentiostat.

SPECIFICATIONS

Operating temperature range	- 40 to 150 °C
Temp. accuracy	±0.3 °C
Dimension	D 79 x H 94 mm (121.90 clearance)
Sample diameter	up to 27 mm
Sample thickness	up to 5 mm
Weight	900 g

Compatible with

- Intermediate temperature System (ITS)
- MTZ-35 Impedance analyzer
- Bio-logic potentiostat/ galvanostat/FRA
- Second PT-1000 Temperature probe

MTZ-35 SPECIFICATIONS

Cell connection	
Operating mode	impedance measurement
Measuring configuration	2,3 and 4 wire
Input BNC	grounded BNC
Generator	
Frequency range	10 μ Hz to 35 MHz
Accuracy	$\pm 0.05\%$ of the desired frequency
Gain accuracy	0.1% + 0.001/kHz $f < 1$ MHz 1% + 0.04% /kHz 1 MHz $< f < 35$ MHz
Phase accuracy	0.02° < 10 kHz $f < 10$ kHz 0.05° + 0.0001°/ kHz 10 kHz $< f < 35$ MHz
Voltage range AC	± 100 μ V to ± 10 V peak to peak
Voltage range DC	± 100 μ V to ± 10 V
Input range	10 V, 3 V, 1 V, 300 mV, 100 mV, 30 mV, 10 mV, 3 mV, 1 mV peak to peak
Resolution	16 bit
Measurement Ranges	
Inductance	10 nH to 10 kH
Capacitance	1 pF to 1000 μ F
Resistance	1 m Ω to 500 M Ω
Basic accuracy	0.1%

Output

Output voltage	0 V to 5 V peak
Output impedance	50 Ω
Output resolution	50 μ V to 5 mV level
Output bias	± 5 V

General

Computer interface	USB2.0
Mains voltage	115 V/230 V ranges ($\pm 10\%$)
Power consumption	30 VA max
Size & weight	530 x 525 x 184 mm (L x W x H), 12 kg



Temperature Control Unit	Operating Temp.	Features	Catalog n°
HTF-1100	RT to 1100 °C	Heating rate adjustable K-type thermocouple	097-110
In-plane ITS	-35 to 150 °C	Temperature accuracy: 0.3 °C	097-140/11
Through-plane ITS	-35 to 150 °C	PT1000 probes	097-140/12

Sample Holders	Operating Temp.	Features	Compatibility	Catalog n°
HTSH-1100	RT to 1100°C	Quartz tube for controlled atmosphere Leak-tight up to 2 bar relative K-type thermocouple	HTF-1100 Tubular furnaces	$\Phi=25$ mm
				$\Phi=12$ mm
				$\Phi=06$ mm
				$\Phi=03$ mm
CESH	-40 to 150 °C	Leak-tight up to 2 bar relative	ITS Other temperature units	In-plane
				Through-plane
HTCC	-50 to 180 °C	Cell factor: K = 1 +/- 5% cm ¹ volume: 0.5 - 1.0 mL	MCS 10	Platinized (x10)
				Non-platinized (x10)



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