# *Electrical Energy Storage Tester*

## *EEST-511-S*

### Semi-Automatic Charge-Discharge Battery Bench

1 channel 50 V / 100A
(Ni-CD, Pb, Ni-Mh, Li-ion ...)

# TECHNICAL DESCRIPTION




ATEQ OMICRON – 8, route de Chevreuse – 78117 Chateaufort - France
Tél : +33 (0) 139 075 002 – Fax : +33 (0) 139 075 019
e-mail : info@ateq.com – Site : www.ateq.com – SAS au capital de 39 200 € - RCS Versailles B 377 915 871

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# 1. SYSTEM DESCRIPTION

## 1.1 General objectives of the system

The system is a semi-automatic charge/discharge bench designed to ensure the maintenance of batteries. For each maintenance step (charge, discharge, deep discharge), the operator enters the parameters for voltage, intensity, alarm or interruption thresholds. The step is then automatically performed by the system.

## 1.2 Type of batteries processed

### 1.2.1. Chemical

Ni – Cd
Li - Ion
Ni – MH
Pb ( liquid or gel )

### 1.2.2. Type of use

The ***EEST-511-S*** is designed to perform all maintenance functions ( charge, discharge, at constant voltage or intensity, control of all key parameters of the batteries and security features).

The ***EEST-511-S*** can be adapted for use in tropical countries (high temperature and moisture environment).

### 1.2.3. Power

Power distributed or absorbed I, in charge or discharge is :

5000 W, or 50 V CC / 100 A

## 2.GENERAL DESCRIPTION – BLOCK DIAGRAM

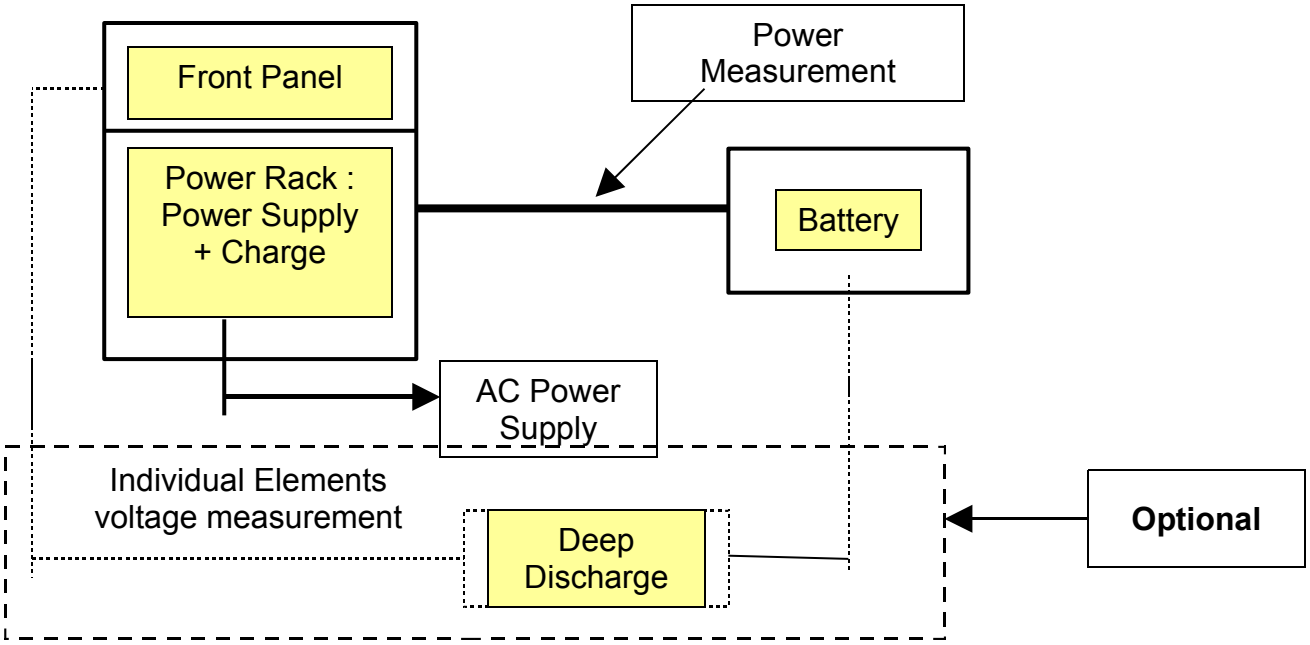
The bench includes I:

- A front panel for command and threshold setting, fitted with :
  - Visualization of electrical power availability
  - Two rotative switches for setting cut-off thresholds in voltage and intensity
  - A timer managing the charge or discharge time

- An electronic charge / discharge module ( power rack ), with power limitation depending on the type of use, fitted with:
  - An emergency switch
  - A power On/Off switch

- A rear connector fitted with :
  - A power and total voltage measurement outlet connected to the battery
  - A battery elements voltage measurement and deep discharge module management outlet ( **in Option** )

### 2.1 General block diagram



## 2.2 Technical specifications of the subassemblies

### 2.2.1 Bench power supply

| SECURITY CLASSIFICATION | |
|---|---|
| Isolation Class: | Class 1 (connected to an earth wire) |
| Network power supply: | Single Phase Voltage 1 Phase + Neutral + Earth 230 VAC<br>Frequency : 50 or 60 Hz<br>Overvoltage Category : CAT II |
| Network consumption | Single Phase : 30 A |

### 2.2.2. Bench organization

The ***EEST-511-S*** is made up of:

- One electronic power supply / charge module (power rack)
- One reading, cut-off threshold detection, charge / discharge switching and setting module

The charge intensity or voltage and the discharge intensity are set manually.

### 2.2.3. Electronic charge / discharge module

| TECHNICAL SPECIFICATIONS: POWER RACK (POWER SUPPLY + CHARGE) | |
|---|---|
| ***Characteristics common to power rack*** | |
| Technology: | Linear |
| AC power supply | Mono 1 P + N + Earth 230 V AC +/- 10 % 50/60 Hz |
| Protection against: | Polarity inversion, overvoltage, overload, temperature rise |
| Generality: | Use inside , altitude < 2000 m (CEI 1010)<br>Relative humidity < 80 % up to 31°C<br>Operating temperature 0°C to 40°C |
| Security: | Conforms to the norm CEI 1010-1 (NFC42.020), simple isolation, relative to electric reading instruments |
| Cooling : | By forced ventilation |
| Power entry/exit | On set-screw connector on back panel |
| ***Power Supply Characteristics: For battery charge*** | |
| Regulation in charge at U $C^{st}$<br>Stability in charge mode at U $C^{st}$<br>Residual ripple and noise | $1.10^{-3}$ for a variation of 10 to 90 % of I<br>$1.10^{-3}$ in full charged over 8 hours, after ½ hour under live electric current<br>10 mV eff |
| Regulation in charge at I $C^{st}$<br>Stability in charge mode at I $C^{st}$<br>Residual ripple and noise | $5.10^{-3}$ for a variation of 10 to 90 % of U<br>$5.10^{-3}$ when fully charged over 8 hours, after ½ hour under live electric current<br>100 mA eff |
| ***Electronic Charge Characteristics : For battery discharge*** | |
| Regulation in discharge at I $C^{st}$ | $5.10^{-3}$ for a variation of 10 to 90 % of U |
| Stability in discharge mode | $5.10^{-3}$ when fully charged over 8 hours, after ½ hour under live electric current |

STANDARD MODULES for integration in the semi-automatic test bench

| Module (Intensity/Voltage) | Presentation | Functioning in charge mode | Functioning in discharge mode |
|---|---|---|---|
| 50 V / 100 A in charge mode and in discharge mode | Rack drawer<br>19" 8U<br>Depth: 570 mm | Constant voltage or intensity | Constant current |

**Note :**
These modules can be provided in a version for tropical countries for use in ambient temperature of up to 60°C.

### 2.2.4. Measurement and threshold cut-off module

The bench is fitted with one ATEQ OMICRON specific board performing power switching, setting and control of cut-off thresholds.

Once the thresholds have been recorded by the board, it will manage autonomously the charge and discharge thresholds. As soon as one threshold has been reached, it will automatically isolate the battery from the charge / discharge system.

| **TECHNICAL SPECIFICATIONS OF THE SPECIFIC BOARD** | |
|---|---|
| Characteristics | |
| Format | 100 x 220 mm |
| Power Supply | 5 Vdc / 600 mA ( with all options )<br>15 Vdc / 100 mA Max |
| **Analog Input / Output** | |
| **4 Input**<br>Resolution<br>Frequency<br>Accuracy<br>PE Error | 0 – 10V<br>12 bits<br>Min 800 Hz<br>+ / - 2 LSB<br>+ / - 4 LSB |
| **4 Output**<br>Resolution<br>Output current<br>Accuracy<br>PE Error | 0 – 5 V or 0 – 10 V configurable<br>12 bits<br>5 mA<br>+ / - 2 LSB<br>+ / - 6 LSB |
| **Digital Input / Output** | |
| 16 Input | CMOS active at 0 Vdc |
| 5 Output<br>10 Output<br>4 Output | Double inverter relay, from which 4 CMOS ( active at 0 Vdc )<br>LED ( active at 0 Vdc ), from which 2 inverse<br>CMOS ( actives à o Vdc ), from which 2 inverse |
| **Resolution depending on the power module ranges used** | |
| 0 to 5 ( V or A )<br>5 to 10 ( V or A )<br>10 to 50 ( V or A )<br>50 to 100 ( V or A ) | 1,22 mV or mA<br>2,44 mV or mA<br>12,2 mV or mA<br>24,4 mV or mA |

## 3. DIMENSIONS AND WEIGHT

The housing of the ***EEST-511-S*** is a 19” in rack is fitted with wheels.

| DIMENSIONS | 19", 12 U |
|---|---|
| Width | 553 mm |
| Height | 670 mm |
| Depth | 600 mm |
| Weight | 75 Kg |

## 4. DESCRIPTION OF FUNCTIONALITIES

**The bench is designed to perform:**

Slow or fast charges at constant intensity or voltage
Slow and/or fast discharges at constant intensity
A third level periodic maintenance

### 4.1. General operating principles

Autonomous channel in charge or in discharge, based on linear technology electronic power supply and charge with manual setting.
The charge intensity or voltage and the discharge intensity are set by a button situated on the front panel.

#### 4.1.1. Cut-off module

The charge and discharge thresholds ( set from the front panel) are :

- In charge ( at I constant ) : U max, -□V or Time
- In charge ( at U Constant ) : I min or Time
- In discharge : U min or Time

The thresholds mentioned above are manually settable and variable depending on your needs.

**High threshold :**

U Max = > battery charge cut-off, at I constant, if the battery has reached the requested voltage, even if the programmed charge time is not complete.

**Low threshold :**

I Min = > battery charge cut-off, at U constant, if the charge intensity has decreased below this level, even if the programmed charge time is not complete.

U Min = > battery discharge cut-off, at I constant, if the battery has reached the requested voltage, even if the programmed charge time is not complete.

## 5.SECURITY

Automatic cut-off, in Charge or in Discharge, as soon as one of the thresholds programmed on the command panel is reached :

High voltage threshold ( for a charge at I Constant )
Low intensity threshold ( for a charge at U Constant )
Low voltage threshold ( for the discharge )
-□V threshold ( for a charge at I Constant )
Time ( for charge and discharge )

- On the rack:
  - 30mA differential circuit breaker on the power supply of the rack
  - Emergency stop
  - Protection by relay on the channel output (battery isolated from the power if the channel is inactive)

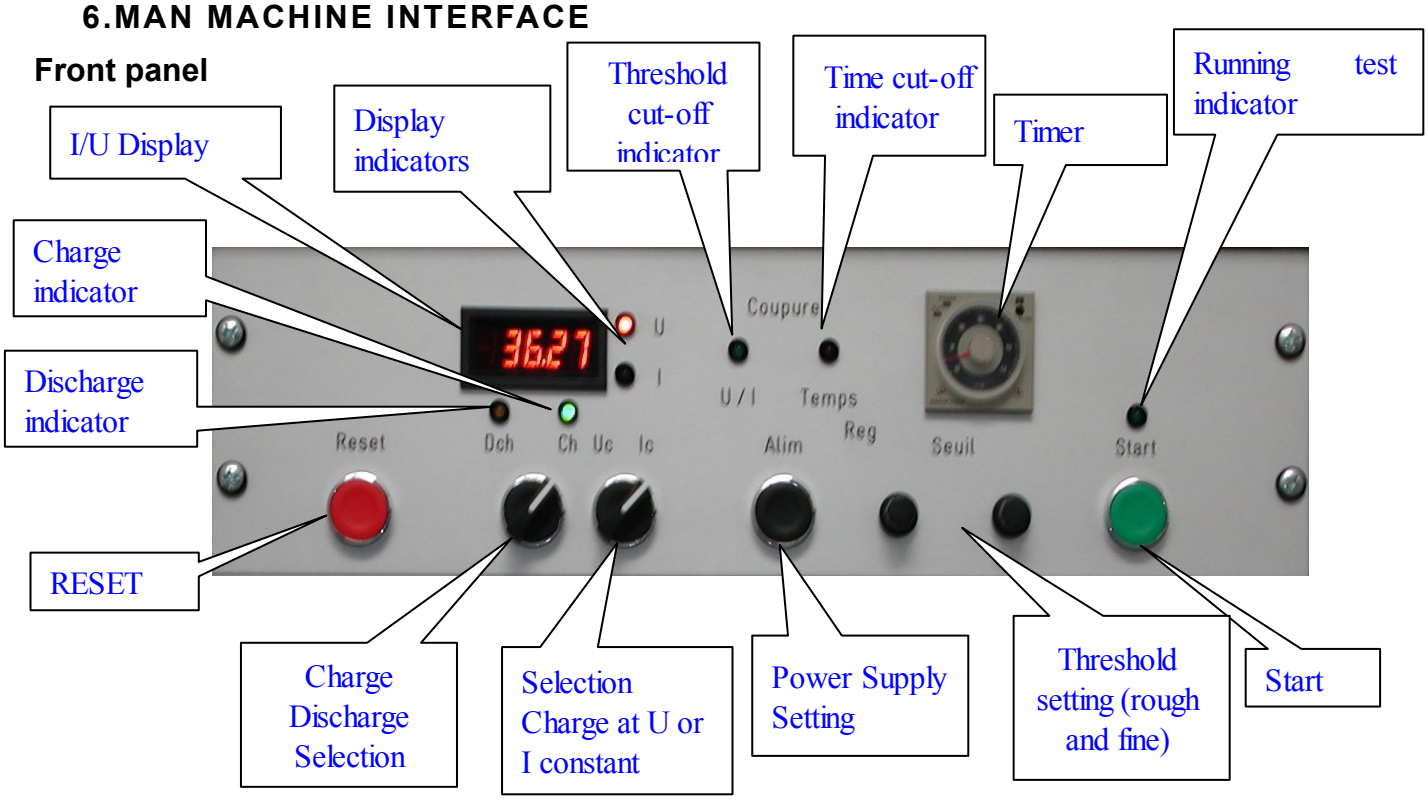
- On the power supply / electronic charge module:
  - Protection against overcharges, shortcuts and polarity inversion
  - Protection against abnormal heating
  - Fuse on the AC power supply

- On the battery : Protection on I or U thresholds in charge and U in discharge

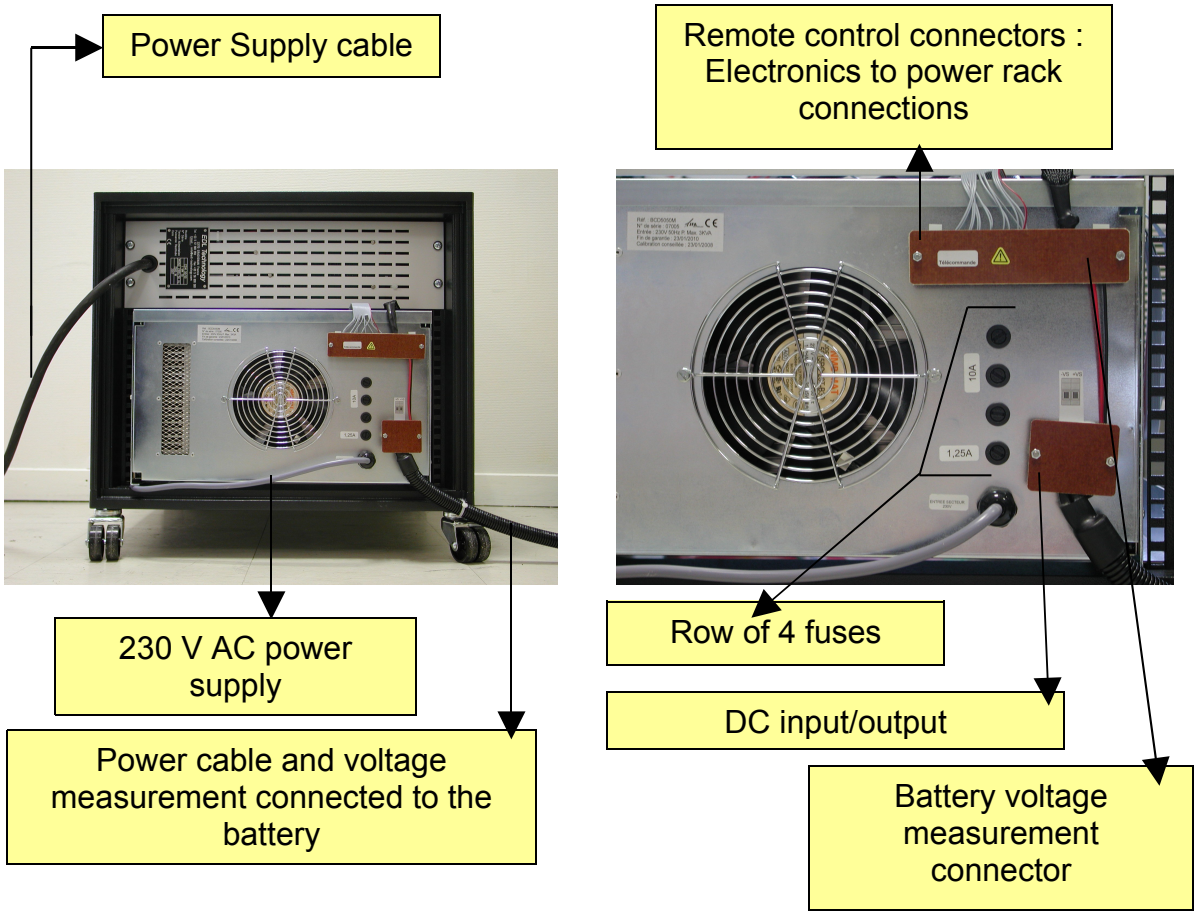
- Visualisation of the voltage or of the intensity upon automatic cut-off of the charge or discharge

## 6.MAN MACHINE INTERFACE

**Front panel**



**Rear panel**




## 7. DOCUMENTATION

The bench is delivered with a documentation in English including :

- The operating manual
- The maintenance manual

# 8. OPTIONS

**Objective of the options**

**Adding automated functionalities to the standard bench**

The aim of the options is to enable performing with a standard battery bench :

- Deep discharges (rebalancing)
- Control of the voltage of each battery element

## 8.1. Connexion module

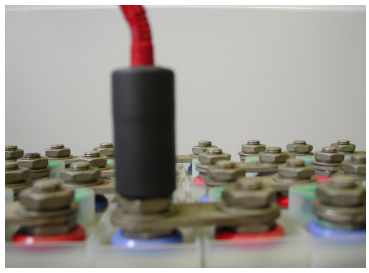
**Foreword**

**Automating the** voltage control of each battery element **and the** deep discharge **(**rebalancing**) requests the independent connection of each battery element.**

**This connection is carried out :**

- **Either through a series of sockets to be screwed on each battery element connection bar.**
- **Or through a battery lid ensuring all connections to the elements.**

### 8.1.1. Sockets



To implement this option, the contacts of the battery elements to be tested should be threaded with enough space to screw the socket on top of the nut.

The sockets are threaded on one side to be screwed on the elements contacts.

Advantage of this solution:

- Simple, reliable and efficient system, with an easy implementation
- Universal System adaptable to all batteries with threaded element contacts
- Very low contact resistance and absence of risk of false contact

Disadvantage of this solution:

- Time to screw the 21 contacts and connect the 21 wires.

### 8.1.2. Battery lid

This tool connects the battery directly to the elements' voltage recorder and/or to the deep discharge box.

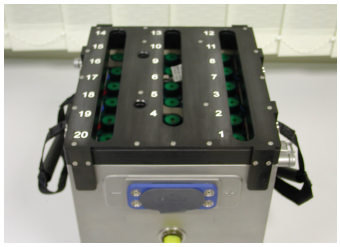
The cable lid is equipped with a 21 spring-loaded type contacts non aggressive and robust system.

Each battery lid proposed by EDL Technology is adapted to one battery type (P/N).

Each tool is designed with four falling edges so as not to deteriorate the contacts during storage of the cover and ease its installation on the battery.

With the lid in place, it is still possible to :

- Measure the battery temperature through a thermocouple probe thanks to shafts placed across the lid.
- To refill the battery with electrolyte thanks to filling windows machined in the lid.



Advantage of this solution:

- Simple, reliable and efficient system with an easy implementation
- Cabling security : absence of risk of permuting the measurement of two elements
- Quick positioning and connection

Disadvantage of this solution:

- Need for one lid per battery P/N, except in the case of two battery P/N with exactly the same dimensions and positions of the elements' contacts.

## 8.2. Elements voltage reading option

The system monitors the voltage of each element and activates a sound and visual alarm, indicating the element(s) outside the range. Depending on the instructions entered by the operator, the discharge stops automatically or not.

## 8.3. Deep discharge option (rebalancing)

Rebalancing the battery elements consists in bringing to the same value the voltages and capacities of all elements.

**Elements rebalancing methodology.**

Rebalancing the elements consists in :

- Carrying out a deep discharge of the battery, bringing the residual voltage of each element to the minimum
- Reloading the battery to full capacity.

The test bench, fitted with the deep discharge and elements voltage measurement options, can perform the rebalancing fully automatically.

The system will automatically manage the deep discharge as follows:

- At the end of the battery discharge (individual element voltage around 1 V for Ni-Cd batteries) connection (by relay commutation) of a 1 ohms resistance between the electrodes of each battery element
- Discharge of the element, at low regime, on this resistance.
  - Discharge time : 16 to 24 hours

To optimize the accuracy of the battery elements voltage measurement during the active deep discharge phase, the deep discharge box should not be further than 0.80 cm (2 ½ feet) away from the battery. Therefore, this box will not be integrated in the rack but placed next to the battery.

This deep discharge (rebalancing) option uses the same lid (or sockets) as for the battery elements voltage measurement.

### 8.4. Sound alarms

Electrolyte level check (activates 30 minutes before the end of the theoretical charge)
End of test alarm (activates at the end of the test, end of charge or end of discharge)

## 9. TECHNICAL PREREQUISITE ON THE CUSTOMER'S SITE

**Connection of the charge/discharge bench to the AC power supply**

The battery bench is to be supplied with AC current

1 phase + Neutral + Earth 230 VAC +/- 10% 50 / 60 Hz
Maximum consumption: 30 A

The connection point to the AC power supply should not be further than 3 meters away from the bench. It should consist of:
Either a wall female plug complying with the local regulations and the technical requirements listed above. In this case, please provide us the male plug to be wired to the bench
Or a wall box fitted with a power cutting device. In this case, we will deliver the bench with stripped cables to be wired directly to the contacts in the box.