



BATTERY CHARGER

BATTERY DISCHARGER at constant current



Technical features and user manual



ATTENTION To reduce the risk of electric shock, do not remove cover. Refer servicing to qualified service personnel.



Read the Instruction Manual carefully before use.

Explanation of Graphical Symbols



The lightning flash with arrowhead symbol, within an equilateral triangle, is intended to alert the user to the presence of uninsulated "dangerous voltage" within the equipment's enclosure; that may be of sufficient magnitude to constitute a risk of electric shock to persons.



The exclamation point within an equilateral triangle is intended to alert the user to the presence of important operating and maintenance (servicing) instructions in the literature accompanying the equipment.

We congratulate you on your choice of premium product, designed to satisfy the most rigorous requirements. This product is covered by warranty.

The relative warranty certificate is attached to the Instructions Manual.

If the Manual is not provided with this certificate, please ask your retailer for a copy.

For further references, please write the serial number in the proper space:

Serial No. _____

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Second Edition

Installation and safety instructions

The ZIVAN battery discharger has been designed to provide safety and reliability. It is necessary to observe the following precautions in order to avoid damage to persons and to the discharger:

- Read the installation instructions contained in this Manual carefully. For future reference, put the Manual in an accessible place.
- Fix the discharger to a stable and flat surface. In case of installation on an elevated surface, it is recommended to check carefully that the discharger is securely placed.
- Ensure all ventilation ports are not obstructed, to avoid the overheating. Do not put the discharger near heat sources. Make sure that free space around the discharger is sufficient to provide adequate ventilation.
- Protect the discharger from water infiltration. Do not pour liquids inside the case.
- Verify that the available supply voltage corresponds to the voltage that is stated on the discharger name plate. In case of doubt, consult a retailer or local Electric Supply Authority.
- For safety and electromagnetic compatibility, the discharger has a 3-prong plug as a safety feature, and it will only fit into a grounded outlet. If you can not plug it in, chances are you have an older, ungrounded outlet; contact an electrician to have the outlet replaced. Do not use an adapter to defeat the grounding.
- To avoid damaging the power cord, do not put anything on it or place it where it will be walked on. If the cord becomes damaged or frayed, replace it immediately.
- Verify that the nominal voltage of the battery to be discharged is lower or equal to the voltage stated on the discharger name plate.
- Do not lengthen the supplying cables, because it would cause some mistake of voltage reading appearing on the display. If it is necessary lengthen the cable by minimum length pieces and with a suitable gauge as to minimize the additional voltage drop (for compensation settings, the instructions contained in this manual).
- Do not try to service the discharger yourself. Opening the cover may expose you to shocks or other hazards.
- If the discharger does not work correctly or if it has been damaged, unplugged it immediately from the supply socket and from the battery socket and contact a retailer.

To be noted: The shown drawings in this manual correspond to the 80V-150A model.

Introduction

The ZIVAN battery discharger at constant current is an indispensable portable device to control the efficiency state of a battery, whether used or new.

It has been designed to replace in a much preferable manner, the classical and bulky power resistor blocks, retaining its reliability, but with the flexibility of electronic equipment.

In the recent years the type of battery present on the market have multiplied, and each battery type has its own charging and discharging features.

Anyway, due to the importance of the electric traction today, which allows both a rational employ of the power resources and a minor disturb of the ecological balance, it is proper to forward some explanation concerning the traction batteries.

A traction battery is usually employed as main power source for the propulsion of industrial vehicles. The lead-acid accumulator is an electrochemical device which accumulates, as chemical power, the electrical power supplied during the charge, in order to feed it again, during the discharge. One battery is characterized from two size: voltage and capacity.

Voltage:

Each lead-acid cell has a 2 Volt nominal voltage (regardless of their sizes)

In order to have higher voltages you have to connect in series more cells, forming in that a "BATTERY" of cells.

The nominal voltage of a battery is obtained multiplying by 2 the number of cells in series.

The voltage at open circuit, of a cell at rest, depends on the electrolyte density:

$$V_o = \rho + 0,84 \quad \text{where: } V_o = \text{cell voltage in V (Volt)}$$

$$\rho = \text{electrolyte density in kg/dm}^3$$

Example: with a density 1,26 kg/dm³ you have $V_o = 2,1V$.

The sulphuric acid concentration decreases during the discharge and consequently the electrolyte density decreases, becoming therefore an indicator of state of charge.

In a state of full charge, the voltage of a single cell is actually included between 2,07V and 2,12V, according to the electrolyte temperature and density. The discharging process causes a decrease of the voltage value, more or less sensible in conformity with the discharging rate. This voltage drop becomes rapid as the voltage approaches the end of discharge, beyond which it is not recommended to proceed.

Capacity:

It is the quantity of electricity which can be supplied from the accumulators to an external circuit, before the voltage decreases under the final limit value and it is obtained multiplying the intensity of discharging current I by the discharging time t expressed in hour:

$$C = I \times t \quad \text{where: } C = \text{capacity in Ah (amperhour)}$$

$$I = \text{discharging current in A (ampere)}$$

$$t = \text{discharging time in h (hours)}$$

The capacity of traction battery is usually referred to a discharging rate of 5 hours (C5), because the real battery exploitation is supposed to be in a 8 hours working day comparable to a constant discharge at a 5 hours rating:

In this case you have the correlations:

$$C5 = I_{nom} \times 5h \quad ; \quad I_{nom} = \frac{C5}{5h}$$

which finds the nominal current of a traction battery.

Battery discharge

Two methods exist to check the charging state of the battery:

1) The measuring method of the electrolyte density.

The electrolyte density is measured by means of an instrument called hydrometer.

This measurement have to be carry out with the maximum care and it has the drawback of depending on the temperature.

In case of an electrolyte temperature equal to 30° you have:

density of about 1,26 kg/dm³ (30 °Bé): charged battery

density included between 1,26 kg/dm³ (30 °Bé) and 1,20 kg/dm³ (24 °Bé): battery partly discharged

density less 1,14 kg/dm³ (18 °Bé): battery fully discharged

2) The measuring method of the voltage during the discharge.

The minimum voltage values of the single cell that can be reached during the discharge depend on the discharging current in conformity with this correlation:

$$V_{stop} = 1,7385 - 0,0385 \times \frac{I}{I_{nom}} \quad \text{where} \quad I_{nom} = \text{nominal current} = \frac{C5}{5h}$$

I = discharging current

Thus discharging with a current intensity equal to 5 hours rating (i.e. I = I_{nom}) the voltage at which the discharging must stop is:

$$V_{stop} = 1,7 \text{ Volt/cell}$$

Operating directions

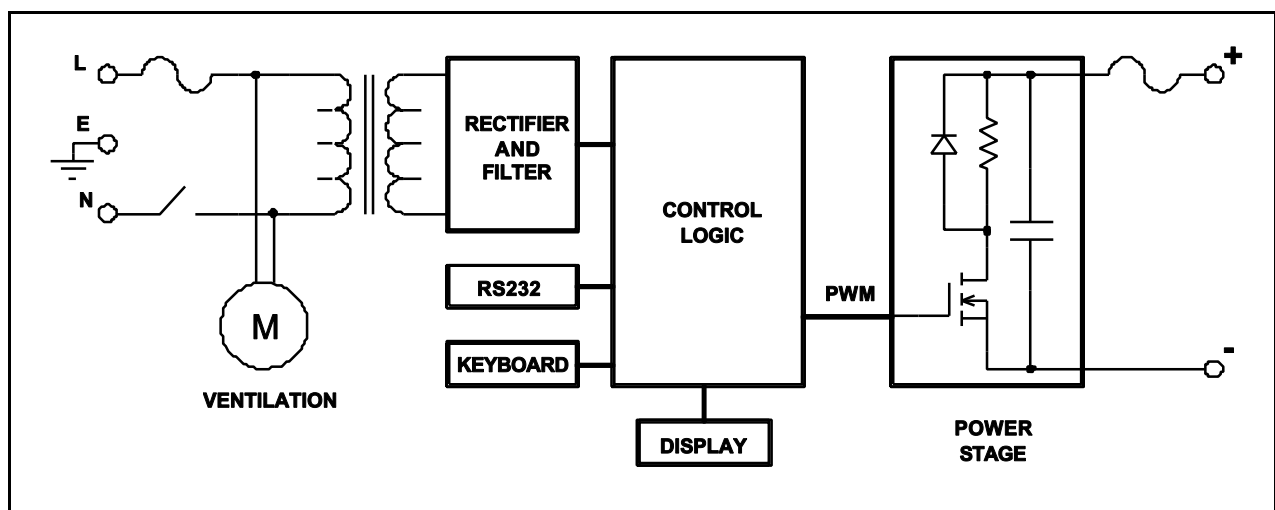
The ZIVAN battery discharger employs the measuring method of the voltage during the discharge.

Such method usually requests the discharging of the battery with constant current till the reachment of the discharging limit voltage V_{stop}.

The property of keeping the battery discharged current constant can be obtained only from an electronic device which changes its own resistance in conformity with the changing voltage. According to the applied battery voltage and to the required discharging current, the discharger automatically selects some different resistors and, with MOSFET technology at 20kHz, executes, through an adjustment of PWM (Pulse Width Modulation), the change of duty cycle necessary to keep constant the current in conformity with the change of battery voltage.

The high frequency electronic control provides smooth DC current draw from the battery, with no ripple. By means of the timer with automatic shut-off it is possible to fix the discharging time. That allows to carry out some partial discharges and in that way to increase the flexibility of the equipment.

Block Scheme



Employing directions

1) Ignition of the discharger

Connect the equipment to the current socket and operate the switch found on the back panel. On the display it appears for few instant:

DISCHARGER
ZIVAN SP1 800-150A

In case of employ of the model with the two units:

- Make sure that the two units are switched off.
- Connect the linkage cable to the sockets of parallel interface.
- Switch on the second unit (the one without display).
- Switch on the main unit.

If this procedure is followed, the display shows double the current compared to the one of the single unit:

DISCHARGER
ZIVAN SP1 800-300A

It is recommended to switch on first the second unit and then the main unit, because on the contrary the equipment would discharge twice the current set and shown on the display. If the current desired is within the working range of the main unit, it is not necessary to use the second unit.

After the introduction the display communicates to connect the battery:

CONNECT THE BATTERY

2) Connection to the battery

Connect the battery respecting the polarity (in case of reversal the display inform about the mistake). In case you want to determine the capacity, ensure that the battery has first been fully charged.

3) Setting out of parameters

In this phase, characterized by the **SET** writing appearing on the display, it is possible to set out the discharging parameters **I**, **Vstop** and **T**, while **Vbat** shows the voltage value read at the time of connection to the battery.

Vbat=25,2 Uslop=19,7
I=001 000 T=9:59

Select the flashing discharge parameter by means of the button **SET** (through which you change from a parameter to the other) and set out the required value by means of the two button - and +.



In every working condition, the lit up LED show which are the operating keys.

I: discharging current.

It is automatically set out at the minimum discharging value (1 or 2 ampere according to the model) and therefore it is necessary to state it at the required value.

This value (constant discharge at 5 hours rating) is normally obtained dividing by 5 the battery capacity expressed with C5. Example: C = 400Ah, I = 400/5 = 80A.

Vstop: Discharging stop voltage.

For safety reasons it is automatically set out at about 80% ofVbat and therefore it is necessary to change it if does not correspond to the required value.

This value (constant discharge at 5 hours rating) is normally 1,7 Volt/cell.

Table of "I" values

C5 (Ah)	I (A)
30	6
45	9
50	10
60	12
80	16
100	20
120	24
180	36
200	40
240	48
300	60
360	72
380	76
400	80
420	84
480	96
500	100
540	108
600	120
700	140
750	150

Table of "Vstop" values

Vnom (V)	Vstop (V)
6	5,1
12	10,2
24	20,4
36	30,6
40	34
48	40,8
60	51
72	61,2
80	68
84	71,4
96	81,6
108	91,8
120	102
132	112,2
144	122,4
156	132,6
168	142,8
180	153
192	163,2
204	173,4
216	183,6

T: discharging time (automatic shut-off).

It is automatically set out at the maximum value equal to 9h and 59m and therefore it is necessary to change it in case you require a partly discharge with timing shut-off.

The timer function with automatic shut-off can be disabled setting out the value **0h e 00m**.

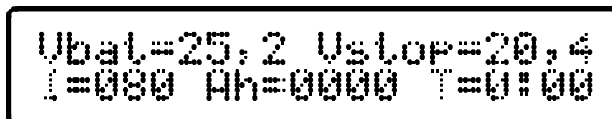
This operation is needed in case you foresee to employ the item for more than 10 hours (slow discharge).

It is usually not necessary to set out the time and it is sufficient to keep the value automatically set at 9h and 59m.

4) Battery discharge

Start the discharge pressing the **START/STOP** key.

In this phase the display shows the following:



Vbat: refers to the battery voltage; it is a voltmeter in all respects.

Vstop: refers to the interrupting voltage of discharge.

I: shows the discharging current.

Ah: shows the discharged amperhours.

T: refers to the past time from the beginning of the discharging (when the timer is disabled, at the reachment of 10 hours the count starts again from 0h 00m).

5) Discharging suspension

The discharge can be temporarily stopped at any time pressing the **START/STOP** key, then pressing it again you enter back into the setting phase of parameters.

In this phase you can decide if to modify the discharging parameters.

Pressing once again the **START/STOP** key the discharge starts up from the point where it was interrupted.

6) Discharging shut-off

The shut-off of the discharge occurs in case of two conditions: when the battery voltage reaches the stop voltage or when the past time reaches the set time.

The condition, causing the discharge shut-off, is shown by the flash of the corresponding parameter.

It is important to notice that the battery discharging voltage rises itself, therefore it is normal that the Vbat and Vstop values do not coincide at the discharging end, even not when that arrived by the reachment of Vstop.

7) Analysis of the issues

In case of constant discharge at 5 hours rating the analysis of issues is very simple:

At the end of the discharge (which usually occurs with Vstop flashing) it is sufficient to compare the value of discharged amperhours with the value forwarded from the battery manufacturer as the battery capacity.

In case the Ah value is very lower than the one forwarded from the manufacturer, it would be necessary to carry out a detailed analysis of each single cell of the considered battery, in order to find out if they are out of repair.

If the Ah value is next to the one indicated it means that the considered battery is, on the whole, in a good condition.

Alarms and diagnostic messages

INVERTED BATTERY :

A battery with inverted polarity has been connected.

BATTERY VOLTAGE
OVER LIMITS !

A battery with a voltage higher, than the one accepted from the equipment, has been connected.

OVER TEMPERATURE
WARNING !

The internal thermal protection starts operating because of an extreme heat.

CURRENT ALARM
SWITCH OFF !

An unexpected current absorption occurred from the electronic section or a dis-alignment of the adjustments set by the factory.

CONTROL ALARM
SWITCH OFF !

The set value is impossible to be discharged or a failure on the capacitor set or main contactors with switching problems (dirty contacts)

In case of the model whit double unit the diagnostic messages will also have the following writings::

CONTROL ALARM
MODULE 1 SWITCH OFF!

MODULE 0 if the failure occurred in the main unit (with display)

MODULE 1 if the failure occurred in the second unit (without display).

Maintenance

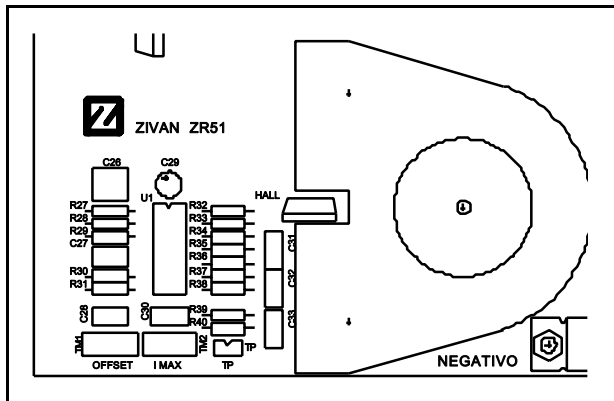
Cleaning

In case of employ in especially dusty places, it is recommended to clean the equipment at regular intervals by means of compressed air, since the fans necessary for its functioning draw in a lot of dust.

Current adjustment

In case of big differences among the value shown on the display and the one read by means of an external ammeter, it is possible to adjust the current through the 2 trimmers placed on the main PCB. We state below, step by step, the operations needed to execute correctly the re-alignment procedures:

1. Switch on the equipment for at least 15 minutes (without starting up the discharge).
2. Connect a battery which can support the maximum discharging current of the discharger .
3. Set an exact ammeter to measure the current externally.
4. Start up the discharge with the minimum discharging current of the discharger.
5. Operate on the trimmer "OFFSET" (TM1) to obtain the indicated value on the external ammeter equal or the most similar to the one shown on the display of the discharger.
6. Start up the discharge with the maximum discharging current of the discharger.



7. Operate on the trimmer "IMAX" (TM2) to obtain the indicated value on the external ammeter equal or the most similar to the one shown on the display of the discharger.
8. Verify with intermediate current levels the correspondence of the values shown on the instruments.
9. Repeat the operations indicated from the point n.4 many times till you get a perfect final alignment.

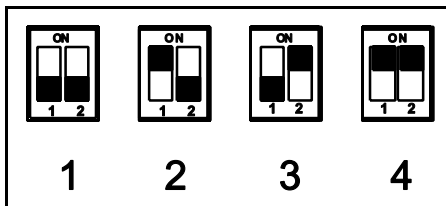
In case of model with double unit:

1. Align the main unit separately.
2. Connect the second unit and repeat the alignment operations acting only on the trimmer of the second unit.

Voltage compensation

In case of a modification of the supplying cable length, the voltage reading can be corrected through 2 little switches placed on the control board.

Four types of compensation can be selected by means of these switches:



1. no compensation
2. compensation "small" (as set by the factory)
3. compensation "medium"
4. compensation "big"

Such compensation should be verified experimentally, since it depends on how the battery has been connected (terminal, thimble, clamps etc.).

Technical features

Feeding terminals

- Input voltage: 230 VAC
- Input frequency: 50-60 Hz
- Absorbed power: 150W
- Input fuse: 0,8A

Battery terminals

- Minimum working voltage: 3V
- Minimum working current: 1A (2A for the model with two units)
- Tolerance of reading value: $\pm 1,5\%$

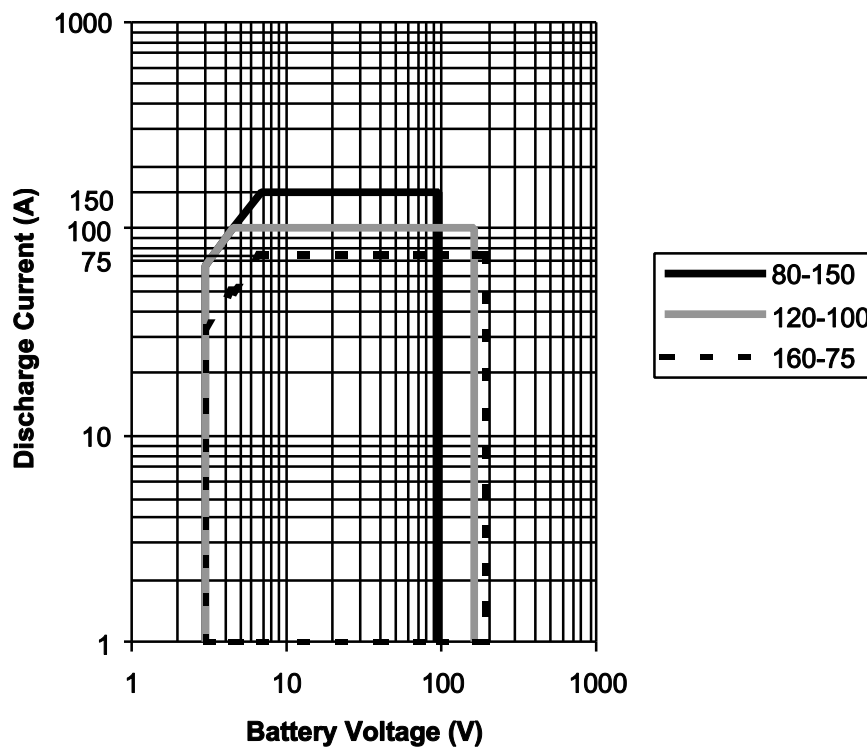
General

- Ventilation: forced
- Working frequency: 20kHz
- Sizes (one unit): 465×265×400 mm
- Weight (one unit): 26kg

Protections and safety

- Inward self diagnostic check
- Thermal protection
- Inverse polarity protection
- Over voltage protection

Operating area (single unit)



Discharge acquisition through PC

The discharger can be remote controlled with PC through the interface RS232.

It is also possible to store and print the discharging curve and all corresponding parameters, showing by documents the executed tests.

The software for the data management is available, as optional, on expressed inquiry from the customer. The commands and the data signalling directly from the discharger have the same efficiency as the commands from the PC keyboard, so that the equipment can work indifferently with or without PC. The description below illustrates the working of the application apart from the standard commands of MS Windows™ and the employ of its windows.

MINIMUM REQUIREMENTS OF THE SYSTEM

To employ this program it is necessary an IBM PC™ compatible with: processor 386 (or equivalent); 4MB RAM; Drive for floppy 1,44 MB floppy disk driver; Monitor or video adapter VGA; Software MS Windows™ 3.1.

PROGRAM INSTALLATION

1. Start up MS Windows™.
2. Copy the floppy disk on the hard disk in a directory called **SBM** (c:\sbm).
3. Enter the **Application** programs groups.
4. Choose **New** from the menu **File** and press **OK**.
5. Type on the drive line **c:\sbm\sbmpc***.exe <parameter>** and press **OK** where parameter corresponds to com1 or com2 in conformity with the connecting point RS232 connector.
Example: **c:\sbm\sbmpce44.exe com1**.

MAIN FUNCTIONS

- Outline the discharger
- Start up and stop a discharge
- Acquire the data of the outstanding discharge
- Visualize the configuration of the discharger
- Visualize automatically the outstanding discharge
- Visualize the previous recorded discharges
- Save automatically in a file the discharging data
- Save in a file the acquired data in text format
- Print the diagrams of the discharges
- Print the tables of the data acquired during the discharge
- Insert the specific data of the tested battery

MENU "File"

Open: it allows to choose between the recorded discharges the one to visualize (operating only when the discharger is disconnected).

Save: it allows to save the discharge with a name fixed or by choice (SCA*.SBM).

New: it allows to restart from the beginning with a new discharge.

Export CSV: it converts in text format*.CSV the acquired data (to employ, for instance, with MS Excel™).

Print Graph: it starts the graphic print visualized in black and white.

Print Table : it starts the print of the acquired data in a tabular format.

Printer Setup: it introduces to the options to outline the print and the printer.

Exit: it ends the working session.

MENU "View"

A table is viewed with all the configured values for the connected discharger and also the fixed name of the file, where the discharge is automatically saved.

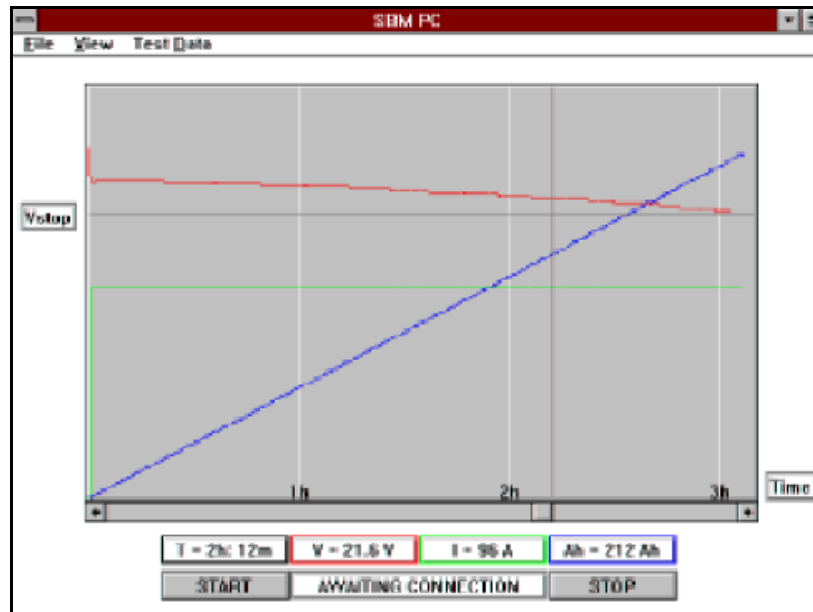
MENU "Test Data"

A table is viewed to fill in with the battery and equipment data that you are testing together with some square to identify the user. These data are related into the print.

DIAGRAM

The diagram viewed the voltage outlines (blue colour), current (red colour) and amperhour (green colour) according to the time.

The constant horizontal line shows the programmed voltage for the end of the discharge (V_{stop}).



CURSOR AND DIGITAL VALUES

The slipping bar bounds the space for the cursor, represented by the grey vertical line into the diagram. The cursor acts as a pointer to visualize into the below squares the digital values of the abscissa in the diagram.

The cursor can be displaced by the mouse moving it or pressing on the side cursors, but it can be moved in a more precise manner by means of the pointers on the keyboard. In alternative with the mouse you can select a zone of the diagram, where the cursor stays automatically. The time scale is automatically fitted, in conformity with the acquisitions, to the available screen.

COMMANDS AND MESSAGES

The lowest horizontal space is reserved to the command of START, STOP and to the operating condition.

START: pressing by means of the mouse the START key you visualize a table containing the configuration data of the next discharge; these data can be modified on line and/or confirmed with OK, starting the discharge with those values.

STOP: pressing by means of the mouse the STOP key you interrupt the discharge in process.

The central space of this window is filled with messages informing the user about the condition of the program, the discharger and any probable failure.

ARCHIVES OF DISCHARGE

When a battery is connected the program combines the new discharge with a name of fixed file and numbered progressively to save automatically the data. Anyway it is possible to personalize the name of the file by means of the **Save** command at any time.

SERIAL INTERFACE RS232**Connector "D" 9 poles**

PIN	Description	Direction
1	NC	-
2	TX	Output
3	RX	Input
4	NC	-
5	GND	-
6-7-8-9	NC	-

**ATTENTION!**

The negative reference on the connector RS232 of the discharger is electrically connected to the negative of power of the battery terminals; the negative reference of the connector RS232 of a PC is electrically connected to its own frame which is usually connected to the ground wire.

Therefore, in case you employ a portable PC (with battery), the connection Discharge-PC has the effect of connecting the battery negative pole to the ground.

In case of a needed galvanic insulation, it is available, as optional, the interface RS232 insulated.

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