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We test, You fly.

BCA SERIES - Battery Charger Analyzer

USER MANUAL P/N: 00430-4860/00430-7540

REFERENCE D2-00430-C / DECEMBER 2024

INTERACTIVE NAVIGATION

EXHAUSTIVE TABLE OF CONTENT

REVISION OF THE MANUAL

We continuously work on improving our products. This is why the information contained in this manual, the device and the technical specifications may be modified without prior notification.

OBJECT	DATE	EDITION	REFERENCE
Creation	August 2020	01	D2-0236-A
Revision	February 2021	02	D2-0236-B
Revision	March 2021	03	D2-0236-C
Revision	June 2022	04	D2-0236-D
Revision	January 2023	05	D2-00430-A
Revision	May 2024	06	D2-00430-B
Revision	October 2024	07	D2-00430-C

ATEQ Aviation Factories:

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Pictures and figures in this manual are non-contractual.

CONTACT

With presence in 40 countries, ATEQ teams are knowledgable, professional and ready to provide efficient service and support to customers worldwide.

A single procedure to get in touch with your ATEQ representative:

ateq-aviation.com
SUPPORT & SERVICES

Contact ATEQ Aviation Support & Services for calibration, follow-up, revision, trouble-shooting and maintenance in real-time. Track the progress of your instrument's service. View quotation statuses and keep in contact with your local representative.

For urgent enquiries, please provide your phone number and wherever you are located, a highly training technician will call you back promptly.

"You may be assured that we will do our utmost to look after your needs".

ATEQ Team.

SAFETY ADVISORY

If the device is supplied with 100 / 240 VAC, it is mandatory to connect it to the ground with a good link to the ground, to protect against electric hazard or electrocution.

Recommendations for the test environment

Keep the test area as clean as possible.

Recommendations for operators

ATEQ recommends that the operators who use the devices have training and a level of qualification that correspond to the job to perform.

General Recommendations

- Read the user manual before using the device.
- The battery charger is designed for industrial room applications and should be handled with appropriate care.
- For maximum efficiency, ambient temperature must not exceed 40°C (104°F). Do not operate near water or excessive humidity (95% maximum). The system is not intended for outdoor use.
- The battery charger uses convection air cooling to regulate internal component temperature. Air inlets are in the right and left side of the device. Outlets are in the back. Allow 1 m clearance around the device for proper air circulation.
- All electrical connections to the device must be equipped with safety systems (fuses, circuit breakers, etc.) adapted to the needs and in accordance with the applicable standards and rules.
- Power supply plug must be grounded.
- Disconnect the device from the mains before performing any maintenance work.
- Do not open a connected device.
- Avoid splashing water on the device.

ATEQ is at your disposal for any information concerning the use of the device under maximum safety conditions.

We draw your attention to the fact that ATEQ cannot be held responsible for any accident related to a misuse of the measuring instrument, the workstation or non-compliance of the installation with safety rules.

In addition, ATEQ declines any responsibility for the calibration or the fitting of its instruments that is not done by ATEQ.

ATEQ also declines any responsibility for any modification (program, mechanical or electrical) of the device done without its written consent.

“We are at your disposal for any information concerning the use of the device under maximum safety conditions”.

ATEQ Team

DESCRIPTION

GENERAL

The BCA series enables the following steps to be performed:

- Charging at constant current
- Charging at constant voltage
- Discharge at constant current
- Rest
- Deep discharge

Stopping a step, pausing, triggering an alarm, generation of messages may occur depending on the various criteria linked to the type of step (voltage, current, temperature, time, cell voltage, capacity values, etc...).

The BCA series can operate in standalone mode or remotely managed by a PC equipped with:

- Windows 10 operating system

- MCMS software (version 6 and above) to manage up to 12 BCA's independently at the same time

- Register the battery type to be tested
- Program, read and modify battery test sequences
- Launch and perform battery test programs
- Store battery test and manage history

- SCSS software (version 6 and above):

- The module can store 50 sequences of 20 steps each
- Configure and set up the device
- Program, Edit, View, Import, Export test sequences to the BCA
- Manage stored BCA tests

Front view

1 – Main switch: O = Power OFF / I = Power ON.

2 – Touch screen panel.

3 – Rotary button, to modify value and validate set points.

4 – Mini-USB port to connect a PC.

5 – External Voltage to measure tension.

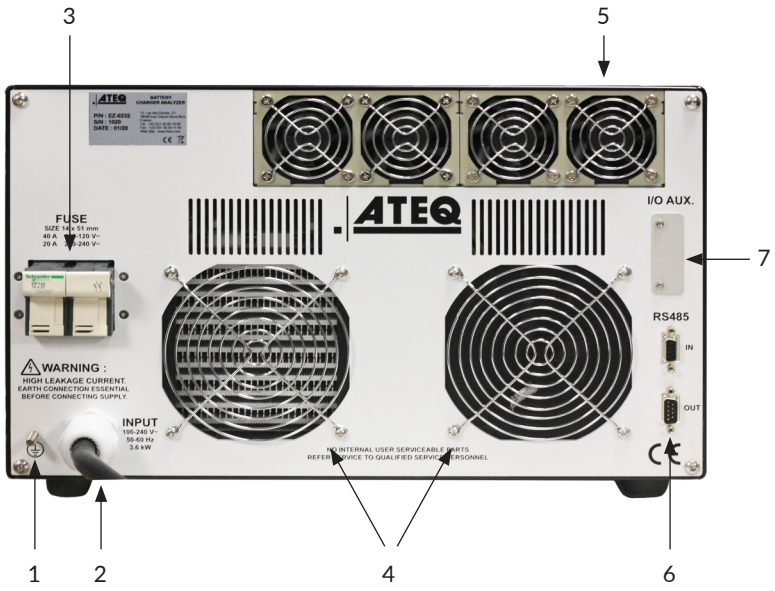
6 – Power output to connect one or two batteries. Composed of one power line and one sense line.

7 – 2 Temperature probe input (1 in Option)

8 – Cell measurement output. Composed of 24 sense lines.

9 - USB port to connect a USB key allowing to download jobs from the BCA.

Rear view



1 – Grounding M6 stud

GROUND must be connected to the device at all time. If electrical installation is not equipped with proper GROUND, Grounding M6 plug must be use.

2 – Power supply cord

3 - Fuse holder:

Requires 2 fuses 20A (for 240V~ network) or 40A (for 100V~ network) – general use– size 14x51mm

Make sure to have the correct fuses installed according to your electrical network

4 - Air outlet

Do not cover; keep 1m clearance for optimal use.

5 - Power supply fan inlet

6 - RS485 input/output

7 - Connector for Option

Accessories

[EC-0326] Rebling © 7007 plug

[EC-0528] Counter-plug Rebling © 7007

[EC-0551] Aligator clip kit for battery cell connection (25 pieces)

[ED-0073] Thermocouple probe type K - 6m

[EG-0400] External probes for Voltage measurement (Black and Red 4mm2)

[EG-0701] USB Type A to Mini USB - 1.8m

[EZ-0191] Deep Discharge Function (No Cable include)

[L2-0010] MCMS - Multi Channel Management Software

[L2-0013] SCSS - Single Channel Setting Software

[MD-0053] M8 Spacers kit for battery cells connection (25 pieces)

[MD-0054] M10 Spacers kit for battery cells connection (25 pieces)

[MD-0055] M12 Spacers kit for battery cells connection (25 pieces)

[T1-0034] BCA Power ouptut cable - 3.5 m - GRID to Eyelet M8

[T1-0043] Cable RS485 SubD 9 pins Male to female - 1.8m

[T1-0106] BCA USB to RS485 sub-D9 - cable 5m

[T1-0132] BCA Power ouptut cable extension - GRID to GRID

[T1-0211] BCA Dual connector Battery cable - GRID to REBLING ©

[T1-0217] BCA Cell measurement cable 24 cells - 3.5m - Souriau to Banana plugs

[T1-0268] BCA Cell measurement cable 24 cells - 3.5m - Souriau to DB25

[T1-0309] BCA Power ouptut cable - GRID to Eyelet M8

[EZ-0361] Remote Cells Measurement Unit (only for PN 00430-7540) included:

- [5040417] Battery Voltage Cable - M12 to Banana
- [5040418] BCA to CMRU Connexion Cable - M12 to M12
- [T1-0469] Cells Voltage Cable for spacer - DB25 to Banana

[T1-0476] Cells Voltage Cable for Cover - DB25 to DB25 from RCMU

Accessories on demand

Power cable output extension

Cell measurment cable extension

Thermocouple Probe Cable Extension

Battery cover

ELECTRICAL CHARACTERISTICS

General characteristics

Sector input	100 - 240 VAC Monophased | 3500 W
Frequency	50 - 60 Hz
Temperature of use	0-50°C (0-20°C without derating)
Storage temperature	-20 to +70°C
Cooling	By forced ventilation
PN EZ-0232 version	Dimension: 380 x 440 x 265 mm Weight: ~26 kg

Power supply characteristics at constant voltage (charging)

Output voltage	0 - 75 VDC per channel | 0 - 48 VDC per channel
Regulation	0.1% for a variation of U from 10 to 90%
Stability	0.1% at full charge for 8 hours
Accuracy	0.1% reading or +/- 25 mV

Power supply characteristics at constant current (charging)

Output current	0 – 40 ADC | 0-60 ADC
Regulation	0.1% for a variation of U from 10 to 90%
Stability	0.1% at full charge for 8 hours
Accuracy	0.2% reading or +/- 100 mA

Electronic Load characteristics (discharging)

Maximum power	1750 W
Absorbed current	0-60 ADC
Maximum voltage accepted	75 VDC | 48 VDC
Regulation in constant current	0.1% for a variation of U from 10 to 90%
Stability	0.1% at full charge for 8 hours
Accuracy	0.2% reading or +/- 100 mA

Gauge input characteristics

Voltage Measurement

Range	+/- 75 VDC | +/- 48 VDC
Accuracy	+/- 0.05% Max of reading (+- 20 mV)

Current Measurement

Range	+ 60 ADC
Accuracy	+/- 0.2% of reading or +/- 100 mA

Internal or External Cells Voltage Measure - 24 cells (Options)

Range	+/- 10 VDC
Accuracy	+/- 0.005 V

Auxiliary Input Voltage (AutoRange)

Range	+/- 80 VDC
Accuracy	+/- 0.05% Max of reading or +/- 10 mV

Temperature (Option)

Range	0 to 100°C (type K thermocouple sensor)
Accuracy	+/- 5°C (apart from sensor)

BCA version 48 Volts / 60 Amps

- 48 Volts max charge and discharge
- 60 Amps max charge and discharge
- Single Battery Charge for 48-60 mode

BCA version 75 Volts / 40 Amps

- 75 Volts max charge and discharge
- 40 Amps max charge
- 60 Amps max discharge
- Charging 2 batteries - 37.5 Volts each max

OPERATING INSTRUCTION

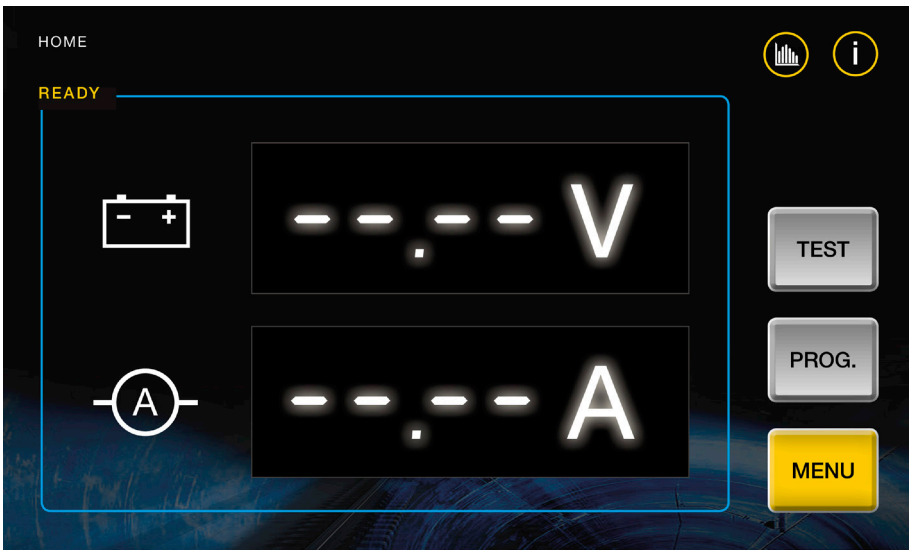
INITIALIZATION

WARNING BEFORE USE: Operator must ensure the device is connected to the ground, either through the input power socket or through hard wiring to the grounding M6 stud.

- Plug the device input socket to the electric network.
  Due to electrical parameter, the device can be connected to a standard 100-240V~ / 40A-20A wall receptacle
- If the function Temperature is active, plug temperature K type thermocouple sensor.
  WARNING: For safety, device configured with type K thermocouple but sensor not connected will start in error mode.
- Turn on the main switch to “I” position to start the device

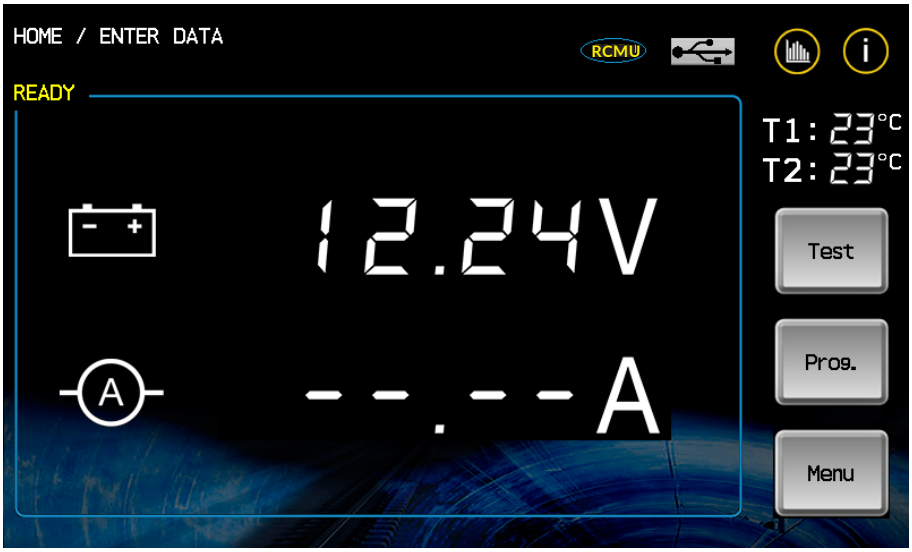
MAIN STATUS SCREEN

When you turn on your device, you have this screen:



Important: Test and Prog buttons are hidden till a battery is connected.

Connect a battery and you should have:



Now you have access to different menu and you can read tension from battery connected.

Cells information (Displayed values or a graph of each cells tension from battery tested)

Messages Informations

Device or USB key Connected

Remote Cells Measurement Unit Connected

Run charge, discharge

To run sequences

Setup your device

TEST MENU

TEST

You are able to have different types of charge and discharge:

CC Charge (Constant Current Charge)

Numbers of Cells: Enter Number of cells

Note: When charging more than one battery enter the total of cells

Main Charge: Enter Main Current and Main Time Charge

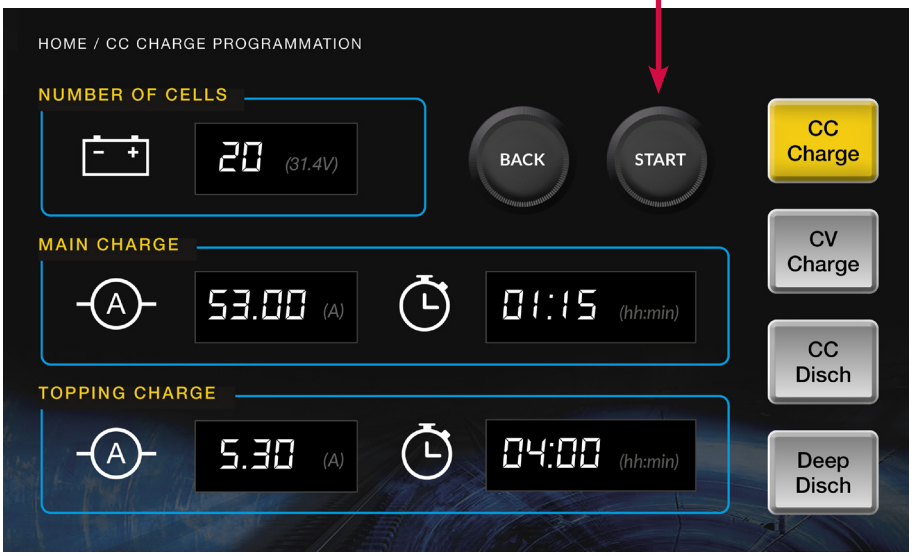
Final Charge: Enter Final Current and Final Time Charge

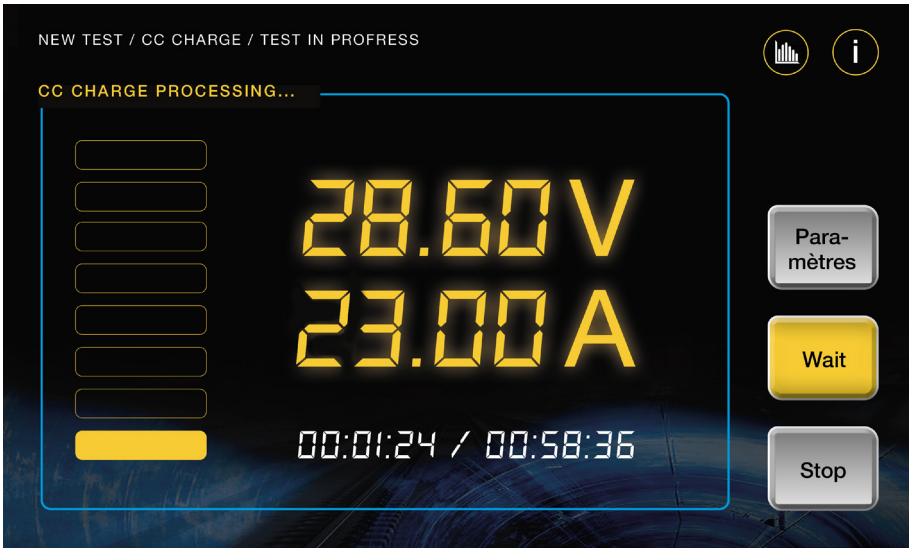
Note: if 0A and/or 00h00min, only main charge will be managed.

Press START: The charge will terminate automatically on Main charge Time + Final Charge Time.

Note: The charge will terminate as a fault if a battery voltage exceeds the equivalent of 1.75V (Value by default, can be adjusted by "Menu" Function)

Press START to run charge



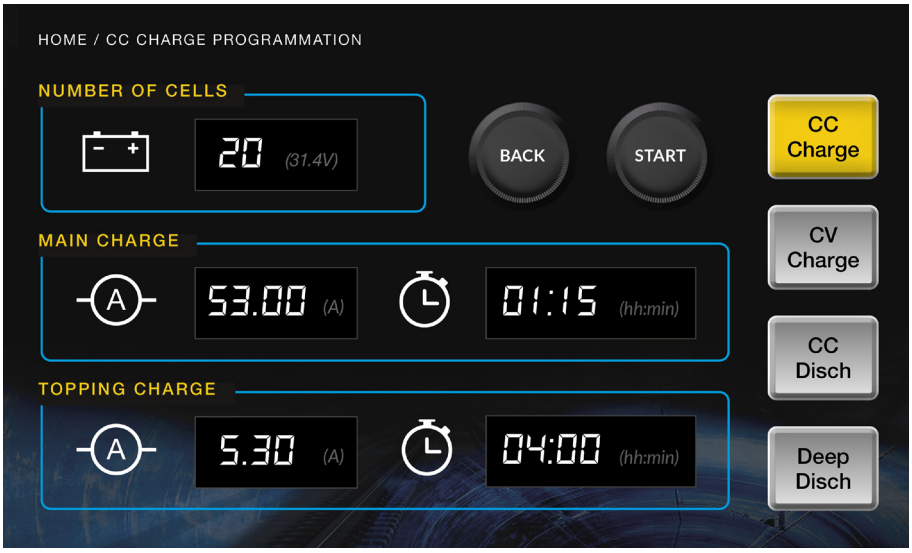


Set a PAUSE touching Wait button

And Stop by touching Stop Button

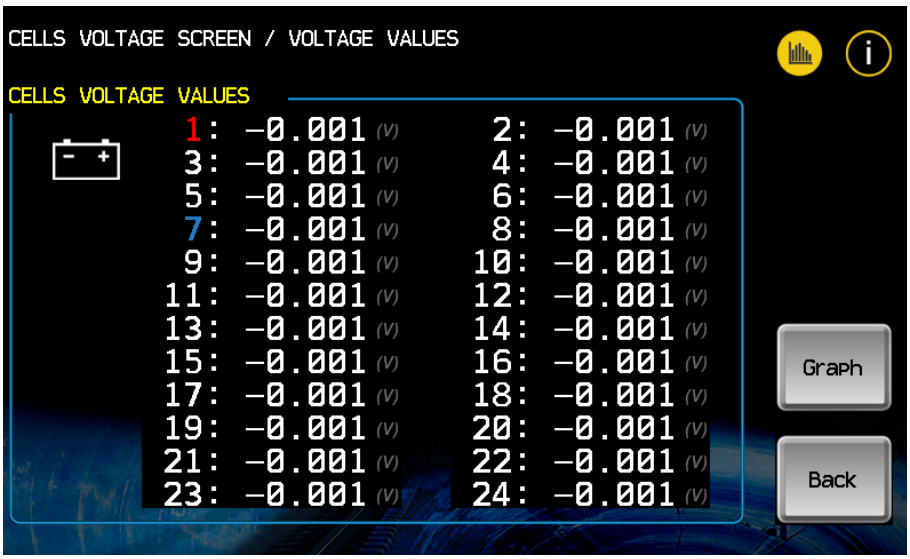
Touch Parameters to modify each value in live mode

Note: If the creation of Job for each test is required with informations (PN Battery / SN Battery / Name of operator), a specific screen will be displayed.



Modification of parameters

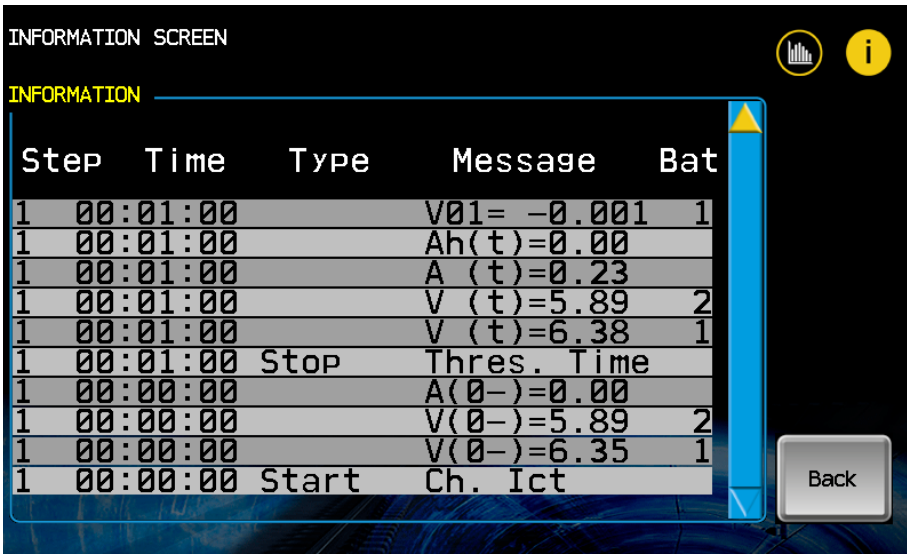
- Press to see values of each cells from your battery



Info cells

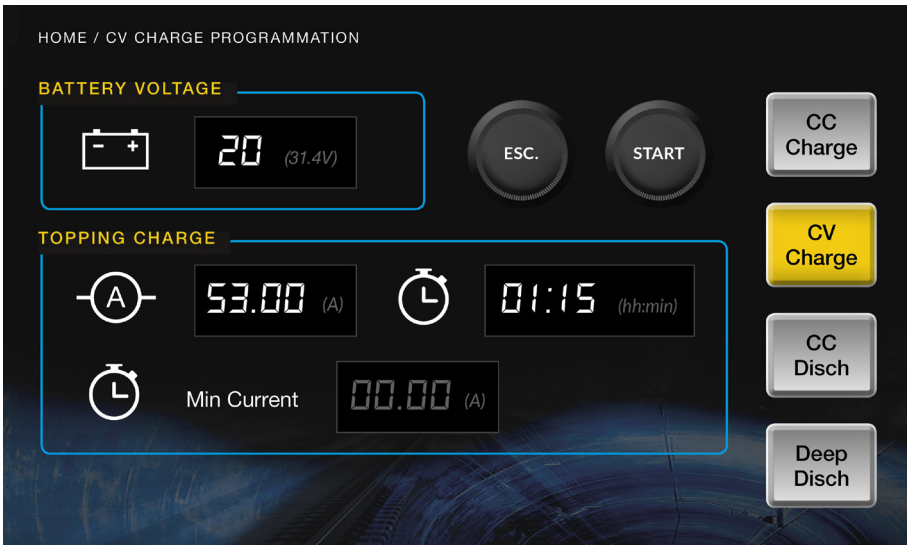
Note: To display Cells informations, you can switch from value to Graph mode.

- Press (i) to have information about the test in progress



Info screen

VC Charge (Constant Voltage Charge)

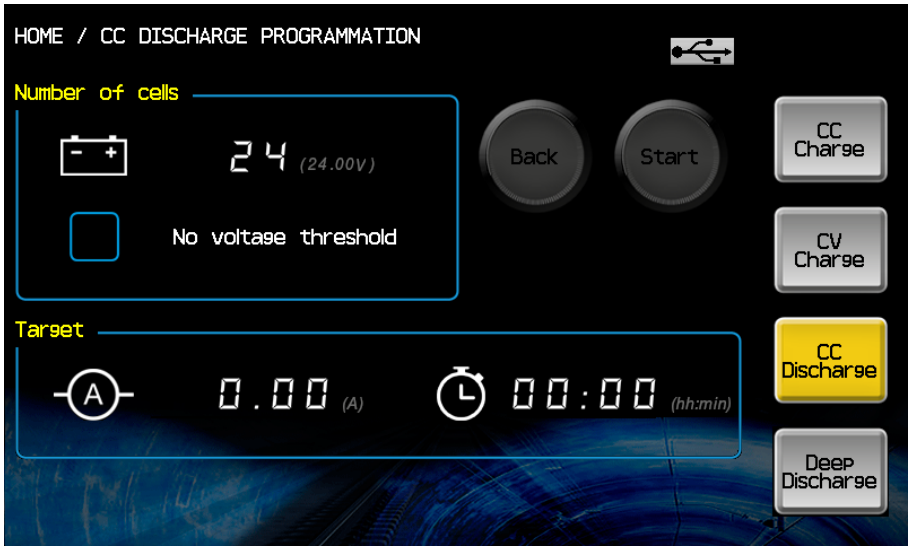


Battery Voltage: Enter the target battery voltage

Main Charge: Enter Main Current, Main Time Charge and the end of charge current.

Press START: The charge will terminate automatically on Main charge time or on end of charge current if value different of 0A.

CC Discharge (Constant Current Discharge)



Number of Cells: Enter the number of cells, Check " Full Discharge" if required.

Target: Enter Target Current and Total Time Discharge.

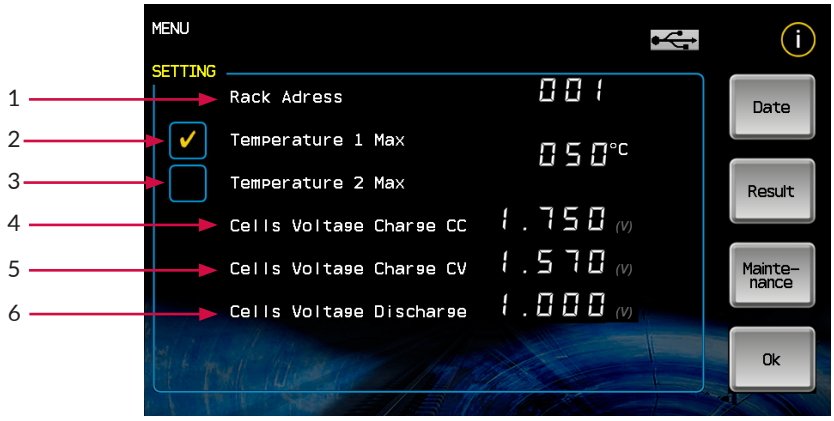
Press START: The discharge will terminate automatically when the time is reached or if the Battery voltage reaches the equivalent of 1V per cell (Value by default, can be adjusted by « Menu » Function)

Note: If "No battery threshold" is activate, battery voltage is ignored during the discharge.

MENU

To access to setup of your device, you have to select “MENU”

You have this screen :



1/ To modify address module, touch on number field, and modify it with rotary button and validate desired value by pressing same rotary button.

Address is important to set, if you use a PC with an ATEQ’s software as MCMS if you have got several modules or SCSS if you have got only one module .

Usually, if you have **one device,** address is : 1. If you have **several devices** you will have, address **1** for **first device,** address 2 for **second device** etc ....

Please refer to page 23 for setting up 2 BCA in series.

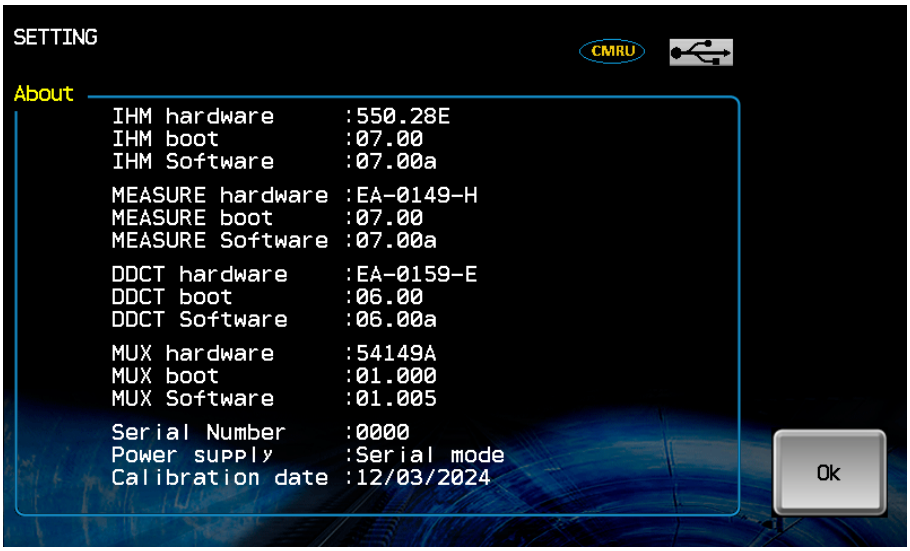
2-3/ To enable the using of Probe 1 / 2 check the Box and to modify value of temperature max for probe 1 and 2, you have to do the same procedure as note 1.

4/ Define value of each cells on Constant Current Charge. To modify it you have to do the same procedure as note 1.

5/ Define value of each cells on Constant Voltage Charge. To modify it you have to do the same procedure as note 1.

6/ Define value of each cells on Constant Current Discharge. To modify it you have to do the same procedure as note 1.

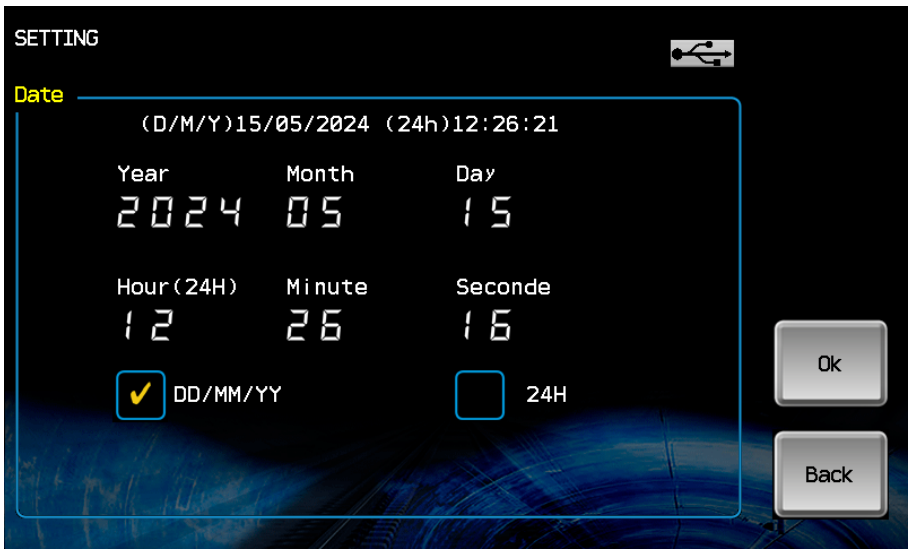
- Press (i) button and you have this screen:



Information on:

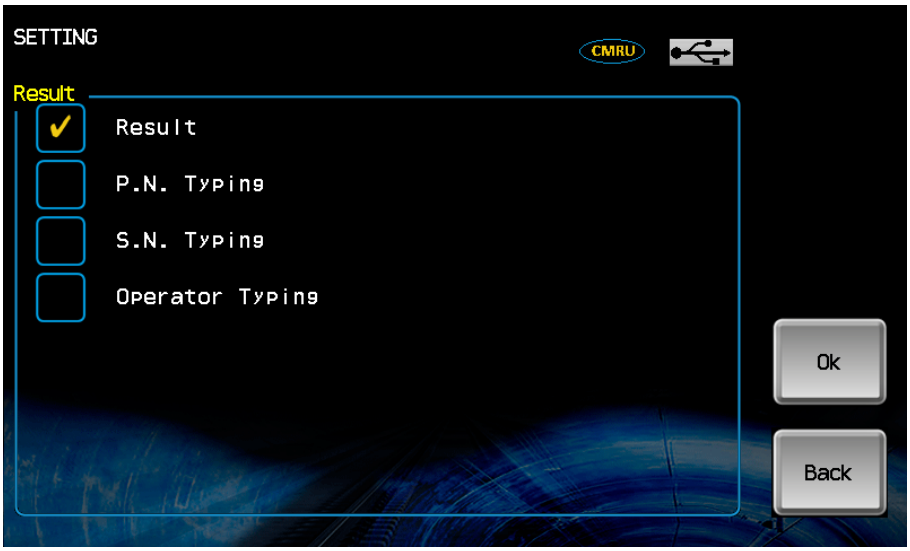
- Serial number of device
- Configuration of power supply (serial mode for 75-40 and parallal mode for 48-60)
- Last calibration date
- Hardware and software information

- Press on "Date" button and you have this screen:



You can check and modify the date, hour and format.

- Press on "Result" button and you have this screen:



Result: is enable, a job will be create for each test.

P.N: is enable, the PN of the battery will be request at the beginning of each test.

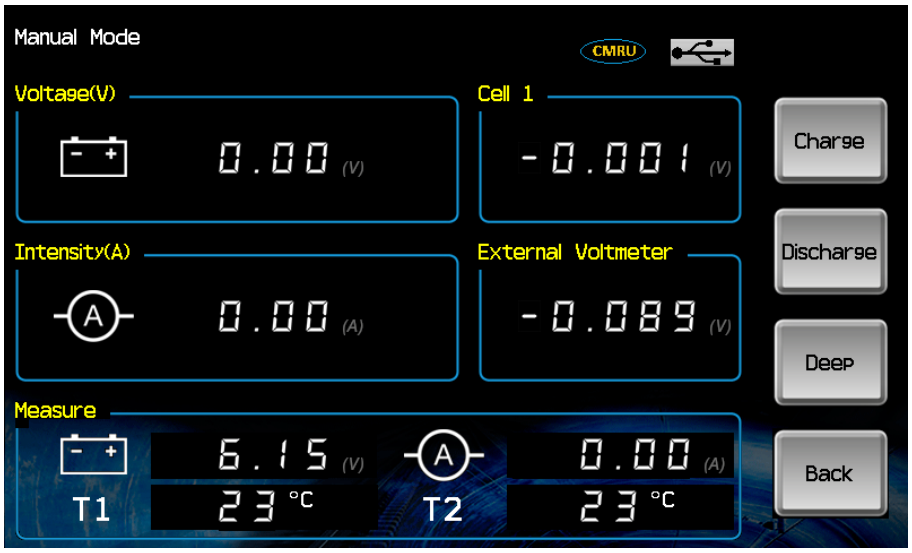
S.N: is enable, the SN of the battery will be request at the beginning of each test.

Operator: is enable, the name of the operator will be request at the beginning of each test.

All informations will be record in an associated job (csv format).

Note: You can download all the jobs directly with a USB key plug on the front face of BCA or with the SCSS software.

- Press on "Maintenance" button and you have this screen:



This MODE is made for quick use.

Set your setpoint Voltage and/or your current and what you want to do and read the different measures.

Press BACK to go back to main screen.

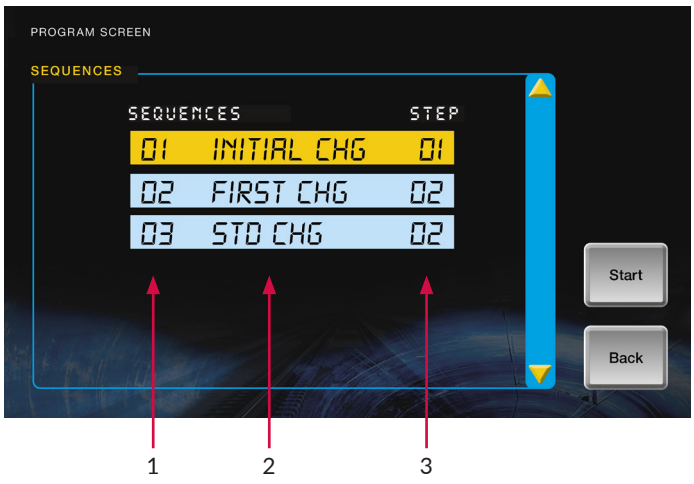
Note: In this mode you don't have any software security to stop the charge or discharge.

PROGRAM

PROG.

Before using this mode you have to previously send by PC and SCSS software, sequences you want to run . Report to the SCSS user manual (D2-0141_ SCSS User manual) to know how to write sequences, send them to a module, download test result...

Below a “PROG” screen example:



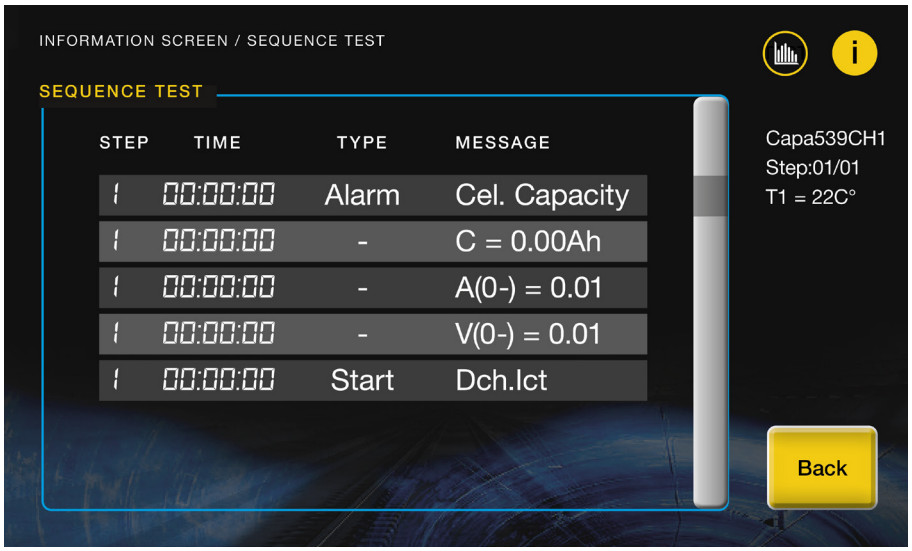
1/ Position of sequence

2/ Name of sequence

3/ Number of steps in the sequence

Press START to run highlighted sequence. (In this example, start by 01: INITIAL CHG with only one step).

- Press (i) to have information about the sequence in progress:



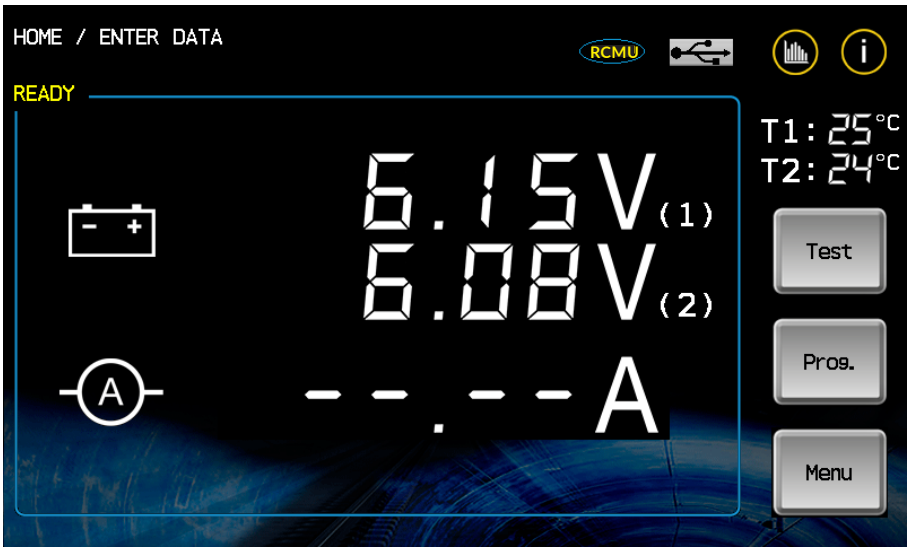
RCMU OPTION (EZ0361: REMOTE CELLS MEASUREMENT UNIT)

This option is designed to manage a second battery by monitoring the global voltage and cells voltage only in charge at constant current mode.

Connect:

- Before switch ON the BCA, connect the RCMU box on the rear face by using the cable reference 504418.

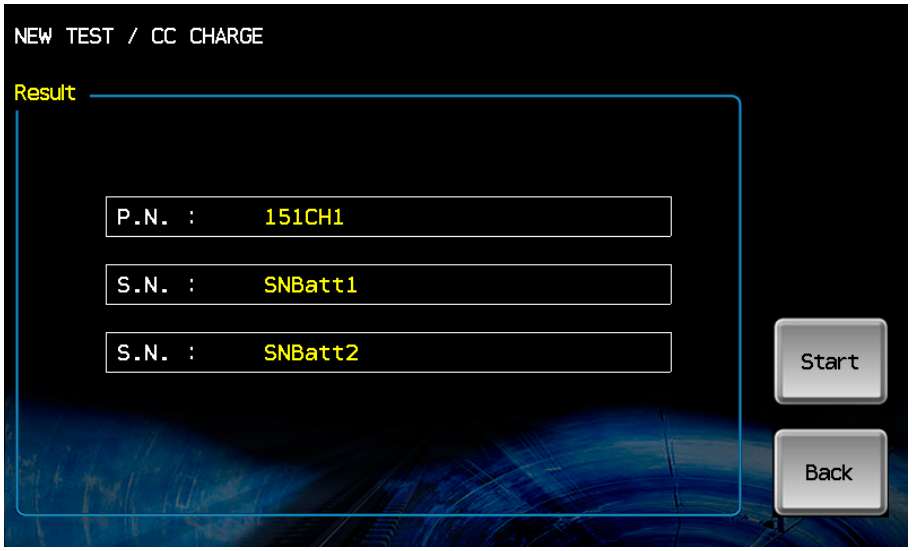
- Connect 2 batteries with the same PN and follow the instruction of the quickstart delivered with the RCMU box.



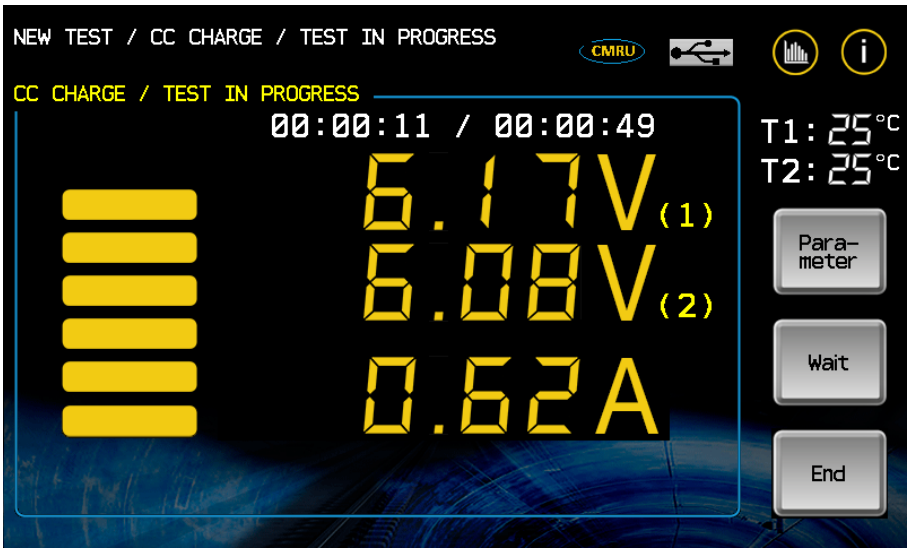
On the screen you have:

- The RCMU icone to indicate that the box is connected
- The voltage of battery 1 (not connected to the external box)
- The voltage of battery 2 (connected to the box)

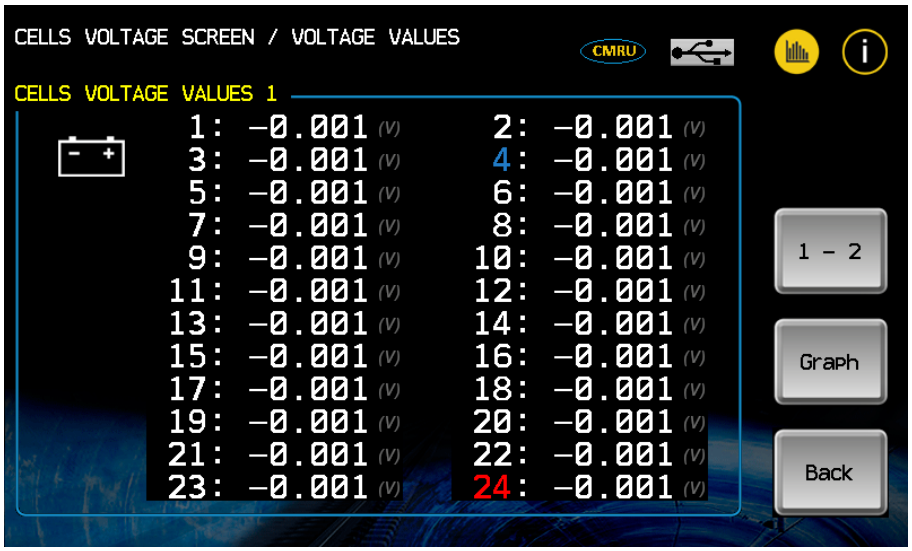
Before launching a new test, if you have configured the rack to enter PN, SN, you have this screen with the 2 SN of your battery:



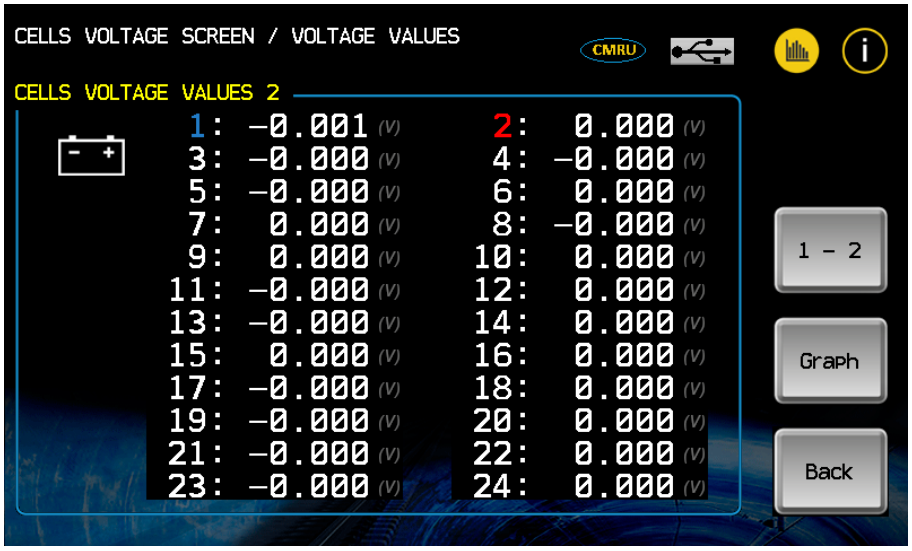
After starting a test you have this screen:



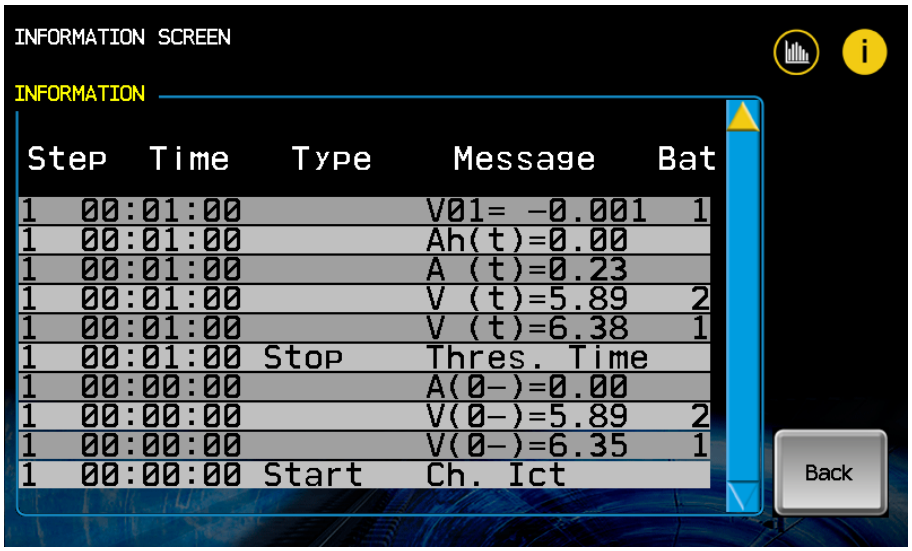
- Press to see values of each cells from your battery:

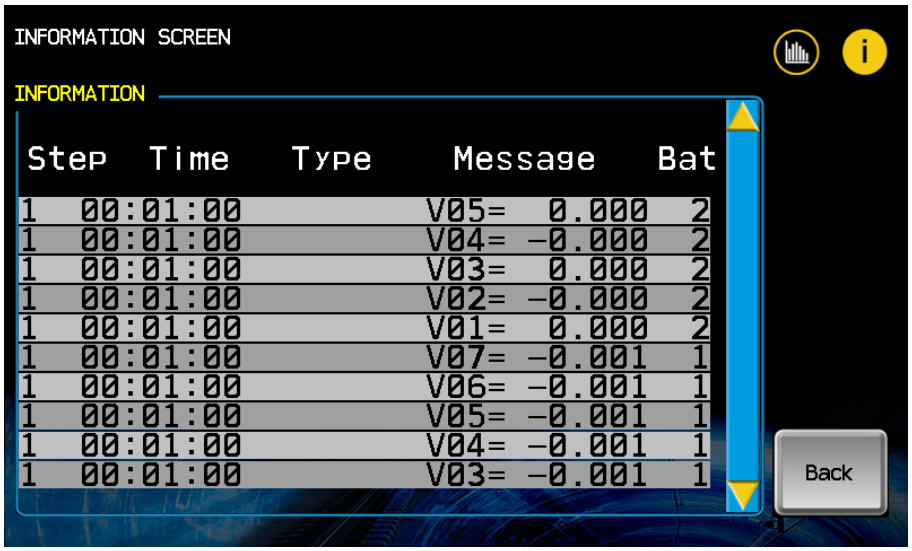


You can switch from cells voltage battery 1 and 2 with the button on the right side:



- Press (i) to see informations:





Note: The value 1 or 2 in the column "Bat" indicate if the information come from battery 1 or 2.

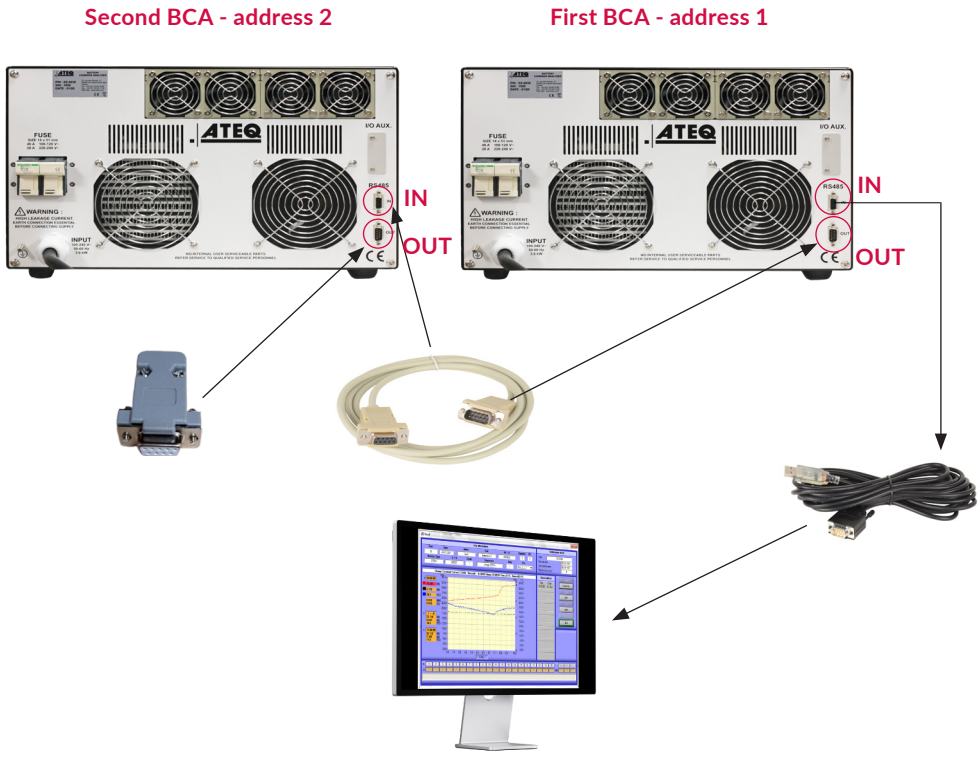
OPERATING INSTRUCTION CONNECTING TWO BCA IN SERIES

SETTING UP TWO BCA DEVICES IN SERIES

This section will explain how to set up two BCA devices in series with the relevant accessories.

This set up only applies if you work with 2 BCAs and you have acquired the ATEQ MCMS software to manage several BCA at a time.

Rear View



1/ Insert USB RS485 side from Cable [T1-0106] USB to RS485 SubD 9 pins male to female - 3m on the PC, then insert male part of the cable into "IN" RS485 port of the first BCA.

2/ Insert male side of the Cable [T1-0043] Cable RS485 SubD 9 pins Male to female - 3m, into "OUT" RS485 port of the first BCA. Insert the female side of the cable into the "IN" RS485 port of the second BCA.

3/ Insert terminal line [EZ-0091] into "OUT" RS485 port of the second BCA.

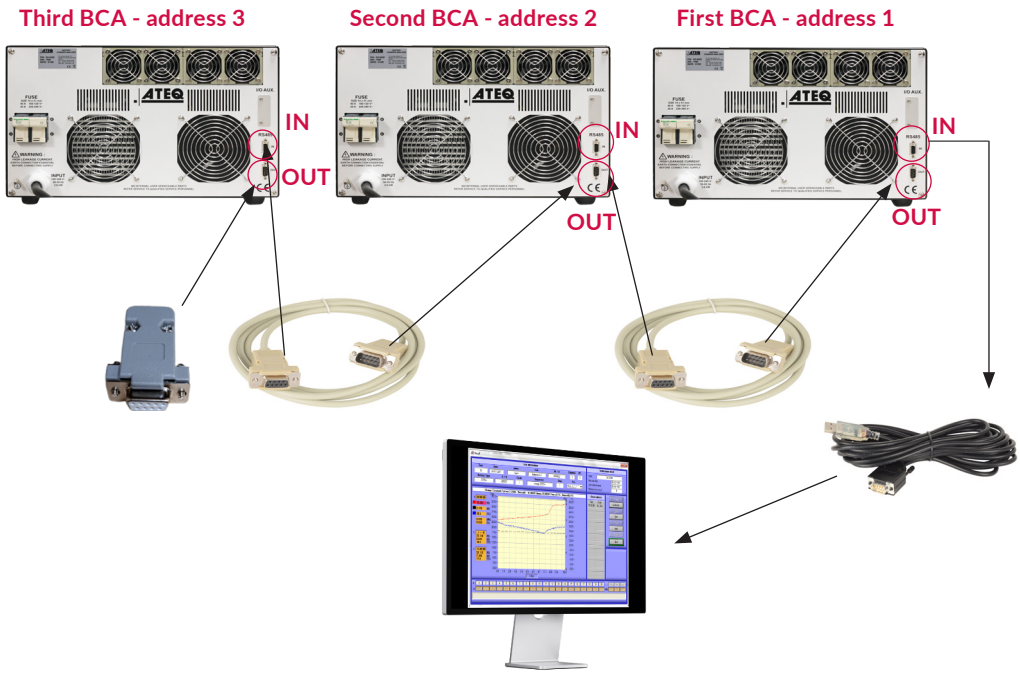
OPERATING INSTRUCTION CONNECTING THREE BCA IN SERIES

SETTING UP THREE BCA DEVICES IN SERIES

This section will explain how to set up three BCA devices in series with the relevant accessories.

This set up only applies if you work with 3 BCAs and you have acquired the ATEQ MCMS software to manage several BCA at a time.

Rear View



1/ Insert USB RS485 side from Cable [T1-0106] USB to RS485 SubD 9 pins male to female - 3m on the PC, then insert male part of the cable into "IN" RS485 port of the first BCA.

2/ Insert male side of the Cable [T1-0043] Cable RS485 SubD 9 pins Male to female - 3m, into "OUT" RS485 port of the first BCA. Insert the female side of the cable into the "IN" RS485 port of the second BCA.

3/ Insert male side of the Cable [T1-0043] Cable RS485 SubD 9 pins Male to female - 3m, into "OUT" RS485 port of the second BCA. Insert the female side of the cable into the "IN" RS485 port of the third BCA. Insert terminal line [EZ-0091] into "OUT" RS485 port of the third BCA.

Note: If you have more than 2 BCA devices carry on setting up the devices with cables like described above.

APPENDIX

APPENDIX A: HOW TO DOWNLOAD JOB FILE

To create a job for each test, you have to enable the case "Result" in the display "Menu -> Result".

To download the job file, you can use SCSS software or plug an "empty" (no data) USB on the front face of the BCA.

Automatically, the USB will be detected, and jobs will be downloaded.

On the USB key:

- One file "ARCH.CSV" where is listed all the test perform on the rack.
    - Each line contain the name of the test with the format "YYYYMMDD" follow by the date, the hour, the number of sequence and name of sequence if the test is perform through a programm or 0 if the test is perform manually, the PN of battery, SN of battery and operator name, if define. The follow information are only for ATEQ.

- Directories with the format YYYYMMDD where is save the job with the format "HHMMSS.CSV".

- Each job file is define by:

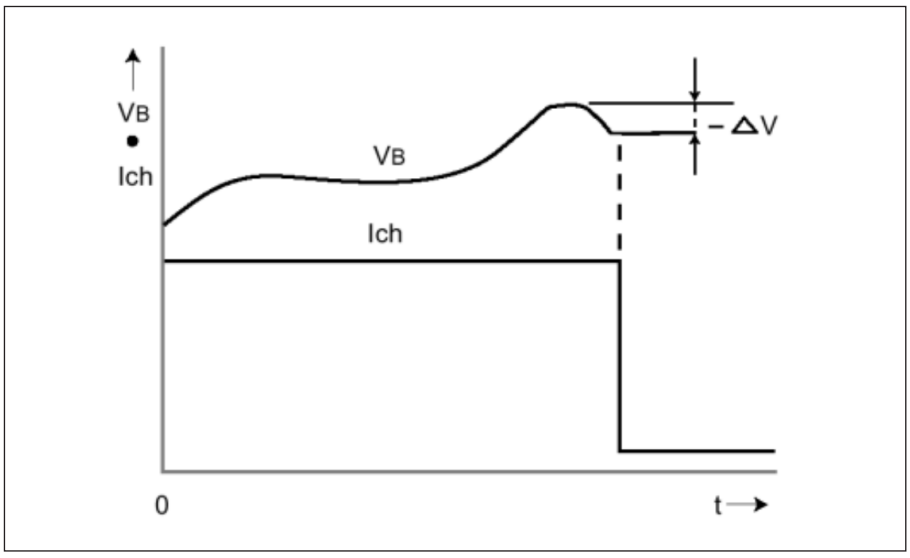
    - Line 1: Name of the file
    - Line 2: Number of sequence (or 0 if manual test) / Name of sequence / PN of battery / SN of battery / Name of operator
    - Line....: step / Time / Code observation / Data

APPENDIX

APPENDIX B: NICD BATTERY (CELL GIVEN FOR INFORMATION PURPOSE)

Charge at constant current

Normal charging should normally be carried out at constant current at **1/10th of the nominal current** of the battery under an available voltage of at least 1.45V per cell. This current must be maintained for **about 14 hours** when the battery is completely discharged at the start. During charging the battery voltage will increase rapidly at first then more slowly until it reaches a maximum voltage of about 1.4V/cell. Charging is then finished. Then, if the battery is still fed with the same current, there will be an overload. The voltage will start to fall, the battery will accumulate no more power and the current going through it will give off heat: This is the moment when the battery starts to heat up. At this moment hydrogen and oxygen are produced in the cells. At 0.1 In, after 14 hours of overload the cells start to self-destruct. The ideal situation for accurately testing the end of a Cd-Ni battery charge is to detect the -dV/dt, or in other words, the moment when the battery voltage reaches its maximum and this voltage starts to fall. This method is strongly recommended for rapid and accelerated charges. We also commonly use detection of the theoretical end of charge voltage level (1.4 V/cell).



Accelerated charging is carried out **at 1/5th of the nominal current** of the battery for a **maximum of 6 to 7 hours**. The overload must not exceed 40 mn to avoid destruction of the cells. This type of charging is quite fast but not as good quality as normal charging.

Rapid charging is carried out at the value of the **nominal current** of the battery for a maximum of **1 hour.** Overloading is prohibited at this charge rate.

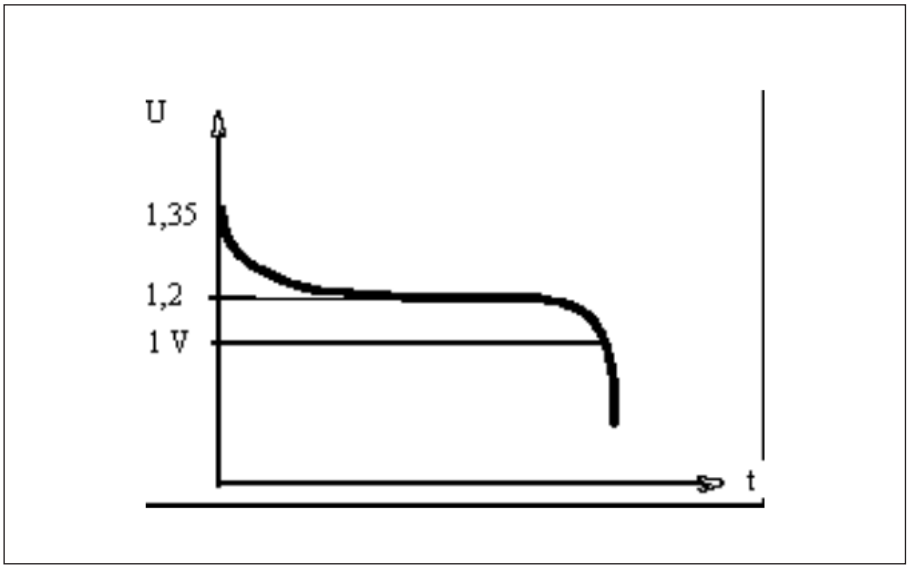
Note: Not all accumulators support this type of charging.

Note: for accelerated and rapid charging, if you do not have a charger with the detection and automatic cut-off at the end of charging (-dV/dt), the battery must be completely discharged before charging.

Continuous charging is carried out at **1/20th of the nominal current** of the battery. The battery is charged but does not overheat after charging has finished (weaker current).

The float current: A battery tends to discharge naturally. After charging a current of **1/100th of the nominal current** may be applied to it indefinitely to maintain its charge at the maximum. This current does not charge the battery, it merely compensates for natural losses (99% of the initial capacity at the end of 10 days, 90% at the end of 30 days).

Discharged at constant current



Ni-Cd discharge curve

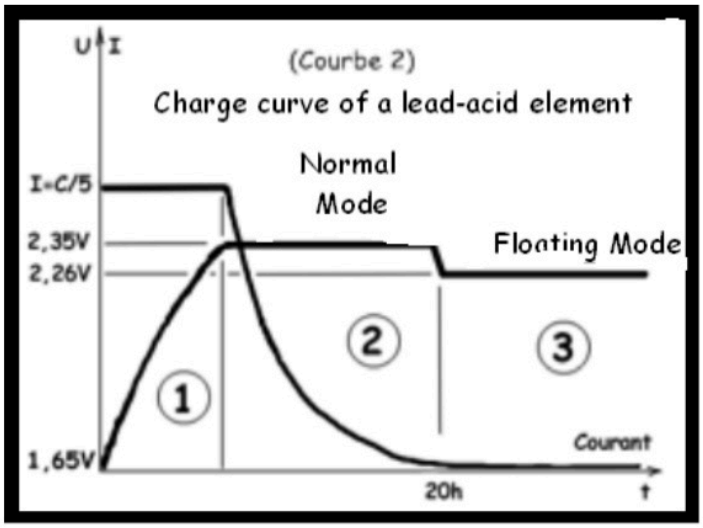
- Common value to discharge : C or C/2
- Discharge stopped when V <= 1V

Note 1: Possibility to make a deep discharge (Discharge to 0V) to errase the memory effect.

Note 2: Ni-Cd batteries are transported and stored discharged. .

APPENDIX C: LEAD BATTERY (CELL GIVEN FOR INFORMATION PURPOSE)

Charge at constant Voltage, with a current limitation phase at the start of charging



Nominal voltage:

Voltage of a cell charged at rest at 25°C: 2.1V/Cell.

Floating voltage (floating charge):

Voltage at which a storage cell can be permanently maintained to ensure it is charged when it is needed: 2.25 at 2.28/Cell at 25°C. This value must be corrected by plus or minus 0.005V by degrees centigrade as long as the temperature falls or rises. At -10°C this is 2.36V and at +40°C 2.21V.

Recharge voltage:

Maximum voltage at which the battery can be charged (but not leaving it continuously). 2.3 at 2.4V/Cell always at 25°C and with the same temperature coefficient of 0.005V/°C. Note, this voltage is a maximum value.

Charge current:

An easy value to maintain is 1/5 of the nominal capacity in 20 hours. In fact, manufacturer's instructions give values in the order of 1.7A for 7Ah and for example 20A for 85Ah.

Charging method:

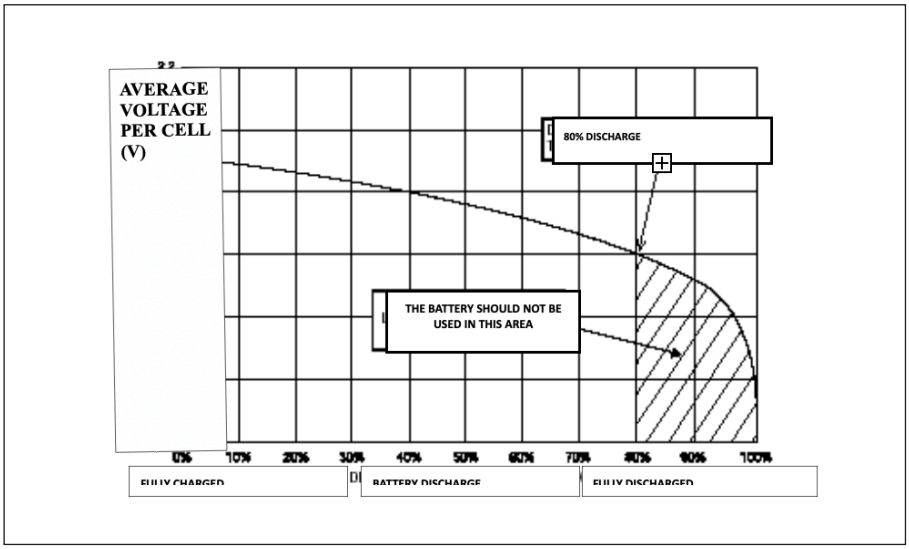
Charging is carried out twice:

In the first part of the charge, limit the current to the maximum intensity permitted by your battery and stop the charging when you reach a threshold of about 2.12V /Cell. (This is charging at constant intensity).

In the second part you move into voltage limitation mode. There are two solutions. Either your battery is intended to remain always connected to the charger or the voltage value to be imposed will be the floating voltage recommended by the manufacturer (about 2.26V/Cell). In this case, your battery will only be charged to about 95% of its nominal capacity. (This is charging at constant Voltage).

Or you are going to use your battery quickly and the voltage value to be imposed will be the recharge voltage (about 2.33V/Cell) and then, your battery will be recharged to the maximum. (This is charging at constant Voltage).

Discharged at constant current



Common value to discharge: C or C/2.

The minimum voltage of a discharged element is from 1.6v to 1.9v. The extreme limit is 1.6v.

Note: Pb batteries are transported and stored charged.

APPENDIX D: LI-ION BATTERY (CELL GIVEN FOR INFORMATION PURPOSE)

Charge at constant Voltage, with a current limitation phase at the start of charging.

Li-ion storage cells are charged on a similar principle to Lead storage cells. Charging is carried out under constant voltage, with a current limitation phase at the start of charging. But for this technology control must be very accurate. There are two charging voltage thresholds depending on the generation of your storage cell.

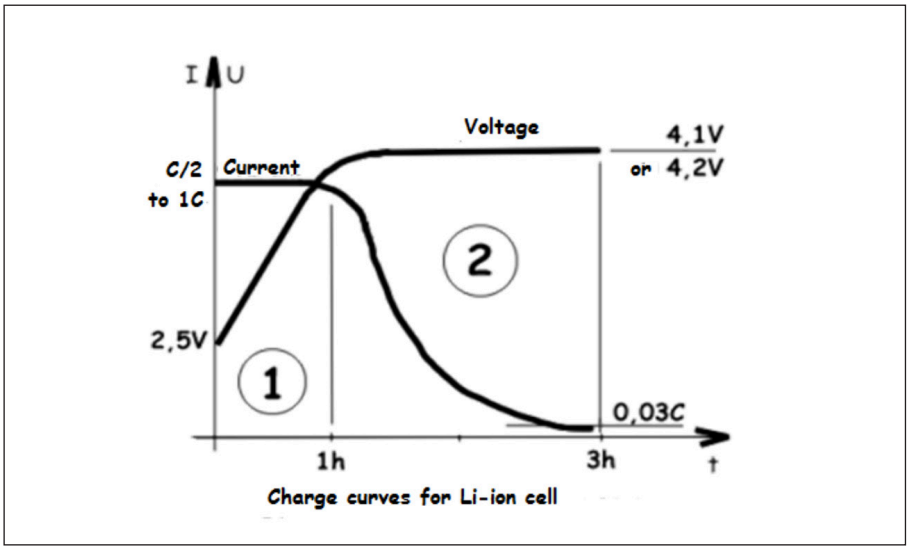
For **the oldest, this is 4.1V** per cell.

For **the most recent, it is 4.2V** per cell.

In both cases this voltage value must be very accurate: **this is +/- 0.05V per cell.**

The **charge of the current** must be limited to **between C/2 and 1C.**

Charging is carried out in two steps:



Charge curves for Li-ion cell

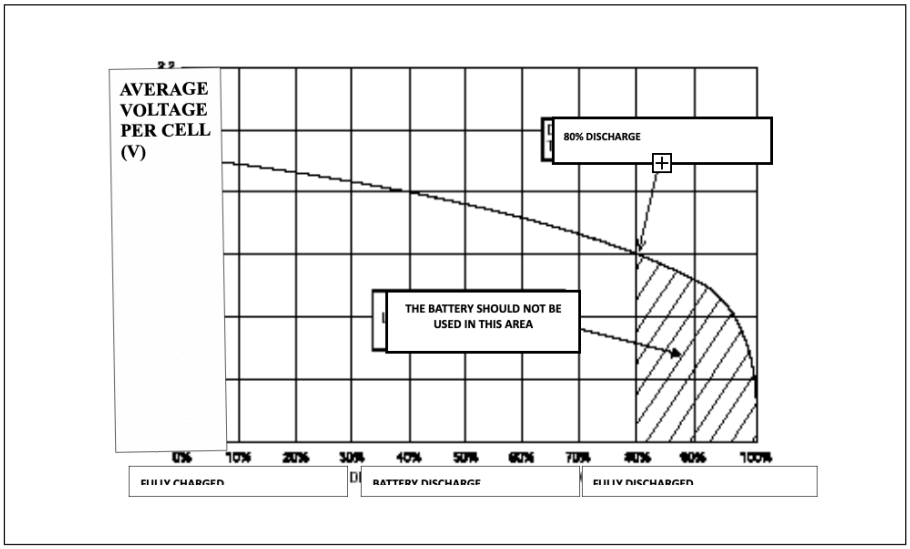
First step: the current is limited to between C/2 and 1C. The voltage gradually increases until its control threshold is reached.

Second step: The voltage is regulated at 4.1 or 4.2V per cell (depending on what the manufacturer has indicated), the current decreases exponentially until it is stabilized at about 3% of the nominal capacity (0.03C). This is the full charge. The charging current must be cut from this moment. The second step is the phase known as the filling stage.

Note: Cutting at Ic < 0.03C is essential. The Li-ion cannot support overloading at all. A Li-ion storage cell must not heat up during charging.

There is no point trying to increase the current to reduce the charging time. Although this would allow the moment of progression from the first to second stage to be reached more quickly, the filling stage would last longer. Moreover, increasing the charging current would directly affect the life of the storage cell. It is therefore preferable to be content with charging at C/2.A slow charge or floating current must not be applied to Li-ion storage cells, this creates metallic Lithium scaling on the electrodes, rendering the cell unstable. To compensate for the weak self-discharge it is recommended that the storage cell is charged for a short time every 500 hours. This recharging will be stopped when the current moves under the threshold of 0.03C.

Discharge at constant current



Discharge curve

Low destruction voltage is 2.5 volts, but it is essential not to drop below 3 volts in use.

In any event the passage between the two limits is very fast, and the discharge voltage curve falls very rapidly.

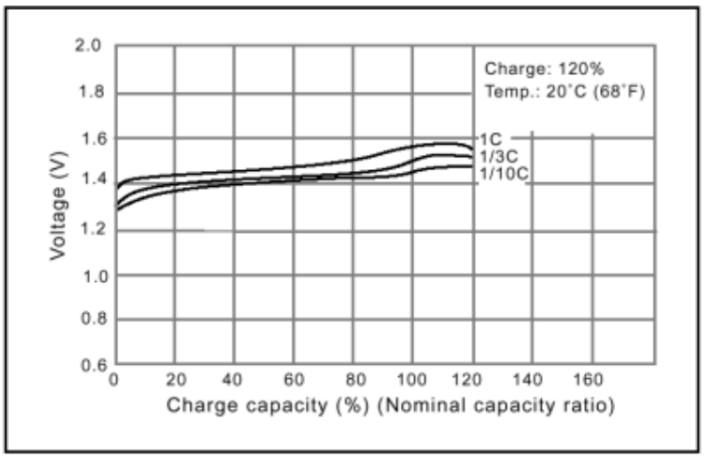
- Common value to discharge : C or C/2
- Discharge stopped when V = 3V

Note: Lithium batteries are transported and stored at a charge level of 40% or 60%.

APPENDIX E: NI-MH BATTERY (CELL GIVEN FOR INFORMATION PURPOSE)

Charge at constant current

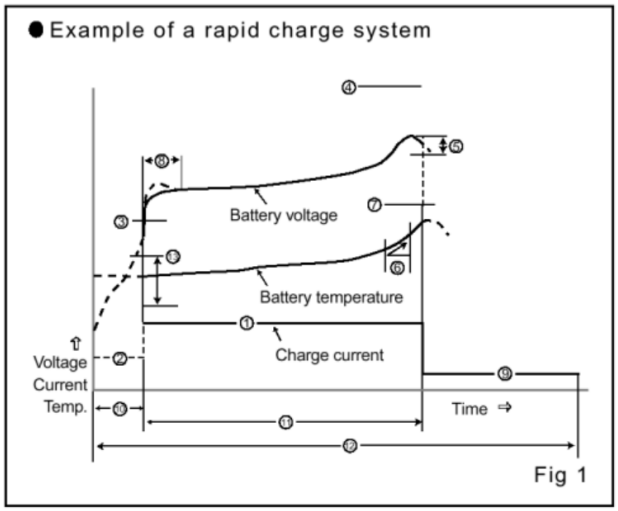
A Ni-MH storage cell charges at **constant current** like the Ni-Cd. The difference lies in the end of charging voltage variations. The Ni-MH voltage has fewer amplitude variations. To the extent that **at 0.1 In** detection of the -dV/dt is practically impossible. **dV2/dt2** (inflection point of the end of the charging curve) must then be detected. There is no question of using the voltage level as this is far too inaccurate. Charging at 0.1 In is therefore difficult to implement due to this end of charge with no remarkable feature.



Manufacturers of **Ni-MH storage cells** therefore recommend a **particular charging method** which will be carried out in several steps. It starts with a **rapid charge of 0.5 to 1 In.** With such a charging current the curve will have a slight drop in voltage at the end (lower than the Ni-Cd) which in spite of everything will enable -dV/dt to be detected. When this moment is detected **the current is reduced to 1/30th In** to end charging with a floating charge.

Note: Ni-MH storage cells do not support overloading very well therefore detection of the end of charging is very important. It is strongly recommended that a time counter is attached to it to limit charging to 90 mn.

These are the different steps and parameters necessary for optimum charging of your cells:



(1) Rapid charging current. This must be between 0.5 and 1 In. Over 1 In is liable to cause overheating and degassing.

(2) Precharging current (0.2 to 0.3 In) if the voltage of the storage cell is less than 0.8V/cell.

(3) Start of rapid charging from a voltage of about 0.8V/cell.

(4) Detection of maximum voltage at about 1.8V/cell.

(5) Detection of the -dV/dt for movement in continuous charge current: 5 mV < -dV < 10 mV/cell

(6) Detection of the -dT/dt for movement in continuous charge current: 1 to 2 °C/mn

(7) Detection of maximum temperature at 50 to 60 °C according to the cell (see manufacturers documentation)

(8) 10 mn delay during which detection of the -dV/dt is inhibited in order not to trigger the start of charging

(9) Continuous charging current 1/30th to 1/20th of In.

(10) Precharging time limiter: 60 mn

(11) Rapid charging time limiter: 90 mn

(12) Total charging time limiter: 10 to 20 hours

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