Battery Charging Centre

ALC 8500-2 Expert

Operating Instructions

Contents:

1 Introduction

Rechargeable cells, and rechargeable battery packs in particular, are a basic requirement for mobile equipment, and nowadays they have found their way into virtually all areas of daily life. Today's consumers expect mobility, especially in the world of communication, and without suitable rechargeable energy storage devices this would all be unthinkable, as primary cells (dry cells) are too expensive to be a viable alternative for many applications. Other areas of activity where nothing "works" without rechargeable battery systems include a vast range of electric tools - and modelling.
Nickel-Cadmium (NC) and Nickel-Metal-Hydride (NiMH) batteries have always played a dominant role in this field, and they continue to do so, especially where high discharge currents are required. For these "high-current" applications the strengths of the old, familiar nickel-cadmium battery are just as important now as they ever were, as their low internal resistance, shallow discharge curve and fast charge capability are particularly significant.
For a given cell size, Nickel-Metal-Hydride (NiMH) batteries offer considerably higher capacity, and they are also much more environmentally friendly since they do not contain cadmium, which is a toxic heavy metal. All the technical parameters of NiMH cells are being improved constantly, and it seems inevitable that they will increasingly take over from NC cells in the future.
However, the full performance capability of a rechargeable battery, regardless of the cell technology, is only maintained if the user cares for it in the appropriate way. Overcharging and deep-discharging have a particularly damaging effect on the useful life of any energy storage device.
Many electrical devices are supplied as standard with chargers which, for obvious reasons of cost, are devoid of any "intelligence", and these crude devices do nothing to extend the useful life of the batteries with which they are used. The modelling world is not immune to this effect, and the useful life of our battery packs - some of them extremely expensive - is greatly reduced if unsuitable charging methods are employed. Often this results in a pack which only delivers a fraction of the maximum possible number of charge / discharge cycles. When you bear these aspects in mind, the cost of a sophisticated, efficient battery charger is quickly recouped.

1.1 The essential performance features of the ALC 8500-2 Expert

The ALC 8500-2 Expert is an absolute top-notch device in terms of battery charging technology, and includes performance features offered by no other charger. It provides four charge channels, operating independently of each other, and capable of carrying out entirely different functions simultaneously. The charger's comprehensive range of functions and program sequences are supported by a large, backlit graphic screen, and the unit is easy to operate thanks to the inclusion of a jog dial and a straightforward menu system.
The ALC 8500-2 Expert supports all the most important battery technologies, including Nickel-Cadmium (NC), Nickel-Metal-Hydride (NiMH), Lead-Gel, Lead-Acid, Lithium-Ion (Li-Ion) and Lithium-Polymer (LiPo).
The firmware of the forward-looking ALC 8500-2 Expert can be updated at any time due to the use of flash memory. This means that the software can be expanded and the charger updated to cope with new or changing battery technologies.
The ALC 8500-2 Expert features four separate charge outputs to which rechargeable cells or batteries can be connected simultaneously; the generously rated mains power supply allows all four channels to operate at the same time.
Charge channels 1 and 2 are designed for battery packs containing up to twenty series-wired cells, and each can deliver a charge current of up to 5 A (according to the cell count; see Table 1). To reduce the waste heat, secondary pulsed switching regulators are used in this section.
Charge channels 3 and 4 are designed for batteries with a nominal capacity of up to 12 V (10 cells); the total rated charge current can be divided up over these two channels in any way you wish.
The charger also features a battery database in which you can store charge parameters for individual batteries; these parameters can then be called up again at any time. When you wish to charge cells or batteries whose data has already been stored, the charger simply uses that data for its processing, eliminating the need to set the charge parameters all over again. The ALC 8500-2 Expert also incorporates an integral data logger which records complete charge / discharge cycles without the need to have

Table 1: performance data of the ALC 8500-2 Expert

Nominal battery capacity, channels 1 and 2	200 mAh to 200 Ah
Nominal battery capacity, channels 3 and 4	40 mAh to 200 Ah
Charge power, channels 1 and 2	max. 40 VA total
Discharge power, channels 1 and 2	max. 40 VA per channel
Charge power, channels 3 and 4	max. 15 VA total
Discharge power, channels 3 and 4	max. 15 VA per channel
Charge voltage, channels 1 and 2	30 V (max. 24 V nominal voltage with NC, NiMH)
Charge voltage, channels 3 and 4	15 V (max. 12 V nominal voltage with NC, NiMH)
Charge current, channels 1 and 2	40 mA to 5 A
Charge current, channels 3 and 4	8 mA to 1 A
Max. dissipated power of heat-sink assembly	90 VA

a PC connected all the time. The charger's USB interface makes it simple to create a PC connection and transfer data for subsequent further processing.
The USB port can be used to control the charger from a PC, and it also supplies a means of reading out the integral data logger. The battery data can then be further processed using the associated PC software.
A pack's voltage level under load conditions is an important criterion when assessing the quality of cells and batteries. However, if a pack is to maintain a high voltage under load, it is also vital that its internal resistance should be as low as possible. To determine the internal resistance of batteries the ALC 8500-2 Expert features an integral battery Ri measurement circuit.
A further special feature of the ALC 8500-2 Expert is its integral lead-acid battery activator (reviver) function, whose purpose is to prevent crystalline sulphate deposits on the lead plates. Crystalline sulphate deposits are a particular problem with lead-acid batteries which are stored for long periods, are seldom used, or are only ever discharged at low currents. The useful life of these batteries can be considerably extended by using the activator function.

A summary of the ALC 8500-2 Expert's most important characteristics and features:

- **Four charge channels, for connecting four cells / batteries**
- **Simultaneous operation on all four channels, even when different functions are selected**
- **Accurate battery capacity readings; ideal for selecting battery packs**
- **Charged-in / discharged capacities can be displayed for each battery individually**
- **Wide range of charge programs for optimum battery care: charge, discharge, discharge / charge, refresh, cycle, test / capacity measurement, forming (balancing), trickle charge after main charge**
- **Support for different battery technologies: NC, NiMH, Lead-Acid, Lead-Gel, Lithium-Ion, Lithium-Ion-Polymer**
- **Lead-acid activator function for elimination of sulphate deposits**
- **Integral battery Ri measurement circuit**
- **Integral data logger for recording and storing complete charge / discharge curve processes**
- **Data retention if mains supply fails; automatic program start when the mains supply is restored**
- **USB PC interface for controlling the ALC 8500-2 Expert; also for reading out the data logger (galvanically isolated)**
- **Display of cell voltage, charge current, discharge current, charged-in capacity, discharged capacity**
- **Integral temperature-controlled cooling fan**
- **Temperature guard circuits for transformer and output stage**
- **Future-proof flash technology for firmware updates and upgrades**
- **Straightforward operation using jog dial and menu control system.**

1.2 Proper use

The charger is designed for charging (fast and normal), discharging and trickle-charging batteries based on the following technologies: NiCd, NiMH, Lead-Acid, Lead-Gel, Li-Ion and Li-Po. The maximum charge current is 5 A, and the unit can charge batteries with a nominal voltage in the range 1.2 V to 24 V (NC, NiMH). No other type of use is permissible; any other usage invalidates the guarantee and negates our liability. The same applies to modifications and conversion work carried out on the unit.

Before you attempt to use the charger for the first time, please read right through these instructions attentively, paying particular attention to the safety notes.

Do not attempt to charge any type of rechargeable battery apart from the following types: NiCd, NiMH, Lead-Acid, Lead-Gel, Li-Ion and Li-Po. Never attempt to charge dry cells with this charger - regardless of type! Dry batteries may explode when charged, potentially causing severe injury.

Note regarding the charging of Lithium-Ion batteries with integral charge circuits
Many Lithium-Ion batteries, such as the Sony NP 500, the JVC BN-V712U or the Nokia 8110 or 81101, are equipped with integral charge / protective circuitry. The basic rule is that batteries with integral electronics must not be connected to the ALC 8500-2 Expert, as the electronics could be damaged, or the batteries might not be completely charged.
Before you connect a Lithium-Ion battery to the ALC 8500-2 Expert, please check with the manufacturer that the pack does not include integral charge circuitry or protective electronics.

Always read and observe the instructions for charging provided by the battery manufacturer.

2 Safety Notes

- The ALC 8500-2 Expert is designed to operate on a mains voltage of 220 - 240 V AC, 50 Hz. For this reason it must be handled with exactly the same amount of care as any other mains-powered piece of equipment.
- This device must not be allowed to fall into the hands of children. Store and operate it in such a way that it is always out of the reach of children.
- Keep the charger's back panel and ventilation slots unobstructed, to ensure that an adequate airflow can reach the integral cooling fan.
- Select a suitable location for the charger: it should offer good ventilation, be out of direct sunshine, well away from radiators and other heaters, motors and anything which vibrates. Never subject it to excessive humidity, dust and heat (e.g. in a closed vehicle). Do not place the charger on a tablecloth, a deep-pile carpeted floor or similar surface, as this could obstruct proper air circulation.
- The device is approved only for use indoors.
- Do not subject the device to temperatures below 0°C or above 45°C.
- Operate the charger only with the case closed.
- The device should only ever be cleaned using a soft dry cloth; if the case is very dirty, it is permissible to moisten the cloth slightly beforehand. Disconnect the charger from the mains supply before cleaning.
- Take great care to avoid any liquid entering the device. If fluid should find its way into the machine, disconnect it from the mains supply immediately, and consult our Service Department.
- Don't leave the packing materials lying around; children could pick them up and play with them, and this could be harmful, e.g. the plastic bags, plastic film or securing bands.

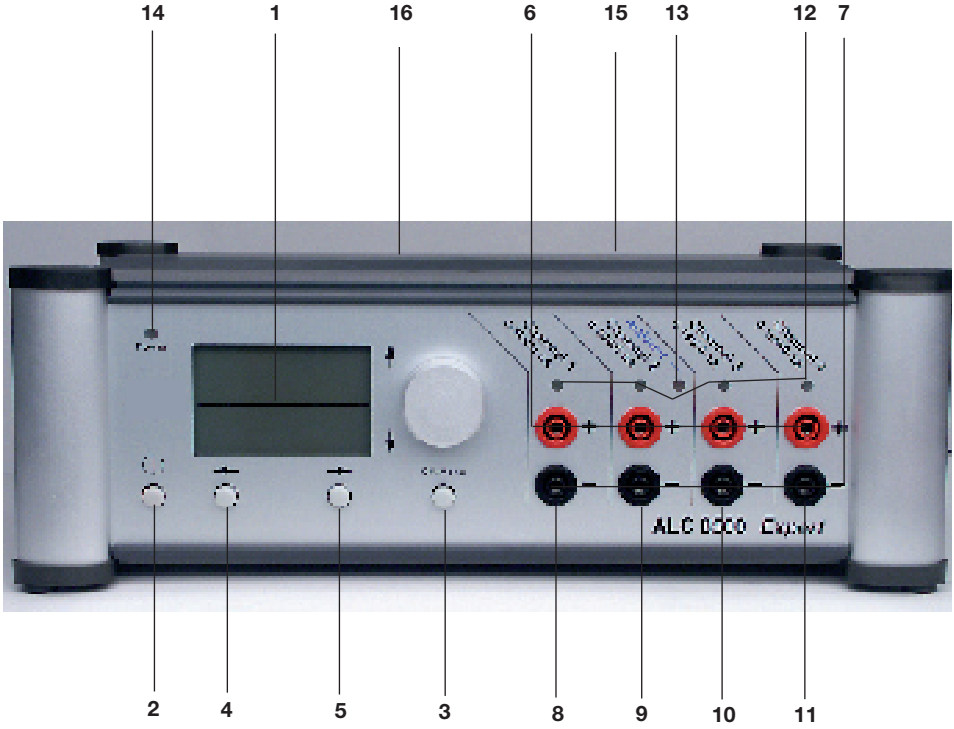
– If you are not sure about any aspect of the machine, do not use it. Consult our Service Department for advice.

Caution!
Before connecting any battery to the charger please check the pack for damage and signs of oxidation, damaged seals and leakage. Don't attempt to recharge any battery in this condition; it is best simply to dispose of it in the appropriate manner, as printed in the disposal label on the pack.

Important: charging multiple batteries simultaneously
The negative terminals of the ALC 8500-2 Expert's four charge outputs are not interconnected internally, and therefore are not at the same voltage potential. For this reason it is **not** permissible to connect batteries to different charge outputs whose negative or positive terminals are connected to each other externally.

Caution! Observe the battery directive!
Defective or exhausted batteries must not be discarded in the household waste. Take such packs to your nearest trade battery collection point, or your local toxic waste recycling centre.

3 Controls, display elements



1. Multi-function LCD screen
2. Mains switch
3. OK / Menu button
4. Cursor button, ←
5. Cursor button, →
6. Battery positive terminal sockets
7. Battery negative terminal sockets
8. Charge output 1
9. Charge output 2
10. Charge output 3
11. Charge output 4
12. Channel LEDs
13. LED lead-acid activator function
14. Power indicator
15. USB interface (back panel)
16. Socket for external temperature sensor (back panel)

4 Charge processes, charge outputs

During the charge process the micro-controller constantly monitors the course of the voltage at each charge output individually. A series of successive measured values is used to assess the charge curve. For best possible results from the charge process the ALC 8500-2 Expert constantly monitors the charge curve for the appropriate battery type with 14-bit accuracy.
Reliable detection of the optimum charge cut-off point is particularly important. With NC and NiMH batteries the charger employs the reliable method of negative voltage difference (peak cut-off) at the end of the charge curve. Charge currents greater than 0.5 C are recommended, as they generate a pronounced Delta-V which the charger detects easily. If the unit registers a voltage difference of a few mV in the downward direction over several measurement cycles at the battery, that channel switches to a trickle charge rate.
The same applies to NiMH batteries, except that the charge curve is shallower than that of NC batteries, and the charger takes this into account. In the case of Lead-acid, Lithium-ion and Lithium-polymer batteries the charge cut-off point is detected according to the current / voltage curve.
Transfer resistances at the terminal clamps can have an adverse effect on the accuracy of the measurement, and for this reason the battery voltage of NC and NiMH batteries is always measured under zero-current conditions. Batteries which have been stored or deep-discharged tend to provoke premature charge termination, but the ALC 8500-2 Expert features an additional pre-peak detection circuit which reliably prevents this occurring.
Where batteries are in a deep-discharged state, the ALC 8500-2 Expert delivers an initial pre-charge at a reduced current.
Most high-capacity nickel-metal-hydride batteries are very sensitive to overcharging, but this drawback is balanced by their immunity to the memory effect, which is a common problem with NC batteries. Long intervals between periods of use, followed directly by recharging (i.e. without first discharging) are one cause of the memory effect with NC cells; another is constant partial discharges followed by topping-up. The electrolyte then tends to crystallise out at the electrodes, thereby obstructing the flow of electrons within the cell. A series of discharge / charge cycles often has the effect of restoring the full capacity of such packs.
Clearly a charger which only provides a simple charge function is not sufficient for optimum maintenance of any rechargeable battery. The ALC 8500-2 Expert offers various programs for comprehensive battery maintenance, all aimed at maximising useful battery life. As you would expect, all channels can be programmed to carry out different processes at the same time.
To dissipate waste heat during discharge processes the ALC 8500-2 Expert is equipped with an internal heat-sink / cooling fan assembly, and a temperature monitor operates constantly at the output stages to protect the charger from overloading in every situation.
Charge channels 1 and 2 are designed for a charge voltage up to 30 V (corresponding to a nominal battery voltage of 24 V with NC and NiMH) and maximum output currents of up to 5 A.
The output currents available vary according to the cell count of the connected battery, as they are limited by the available charge power.
The maximum total charge power for channels 1 and 2 is 40 VA. Please note that the basis for calculating this figure is not the nominal battery voltage; a higher voltage must be taken into account under charging conditions. For example, if an output power of 30 VA is drawn for channel 1, the 10 VA is still available for channel 2. As long as the total power remains below 40 VA, both channels operate simultaneously. If this is not the case, the channel whose process was started last has to wait until the required power is available, i.e. when the charge process of the channel first started is concluded; the second process then starts automatically.
Charge outputs 3 and 4 are designed to operate at a maximum output voltage of 15 V, corresponding to a nominal battery voltage of 12 V with NC and NiMH batteries. In this case the maximum possible charge current is 1 A, shared by the two outputs working simultaneously. For example, if a charge current of 500 mA is selected for channel 3, then 500 mA is also available for channel 4. However, channel 4 can supply 800 mA if channel 3 is only delivering 200 mA.

The main display window always shows whether a particular channel is actively working, and which process is being carried out. A channel LED is also located above each pair of output sockets; the LED glows constantly when its associated channel is working actively. When the process is concluded, the LED lights up briefly every 1.5 seconds. If the process is terminated in an emergency situation, the LED flashes at a high rate.

5 Battery capacities, charge power, currents

Charge channels 1 and 2 are designed for use with batteries whose nominal capacity is in the range 200 mAh to 200 Ah, while charge channels 3 and 4 can work with nominal capacities of 40 mAh to 200 Ah. The essential performance data relating to the ALC 8500-2 Expert is summarised in Table 1 (Chapter 1.1), but please note that the specified performance for NC and NiMH batteries is not based on the nominal battery voltage, but on a cell voltage of 1.5 V. A micro-controller is used to manage the available power.
All four channels of the ALC 8500-2 Expert are capable of carrying out different processes simultaneously. However, if the required power exceeds the specified performance data of the ALC 8500-2 Expert, then the processing occurs sequentially. The screen then displays the message “waiting for power”, and the process does not start until another channel has ended its process, and the requisite power is available again.

6 Battery Ri measurement function

When assessing the quality of rechargeable batteries, the pack’s internal resistance is particularly important in addition to its capacity. High internal resistance has a negative effect especially in high-current applications, i.e. the voltage declines at the battery itself, and energy is converted into waste heat. If the voltage collapses under load conditions the battery appears to be flat, although a useful quantity of residual energy may still be present.
A battery must be at a defined state of charge if its internal resistance is to be determined, and as a basic rule the pack should be virtually fully charged before carrying out the measurement. If you wish to compare different cells it is especially important that they should be at the same initial state of charge.
If abrupt voltage collapses occur when a battery is being discharged, this is a very clear indication that there is a variation in capacity of the individual cells, or that one or more cells are already damaged. If a pack in this state continues to be discharged, the result may be polarity reversal and further damage to the affected cell or cells. In contrast, accurately selected cells always produce highly reliable battery packs which have a particularly long useful life.
For these reasons it is essential to use identical cells when assembling a battery; there should be no different cells in the pack, and certainly no cells of different capacity. The more accurately you select the cells, the better the battery pack, and the longer it will last.
It is often impossible to determine the state of ageing batteries accurately simply by measuring their capacity; checking their internal resistance at a defined state of charge gives a much more accurate basis for assessment. Internal resistance is certainly the most useful criterion for determining a battery’s maximum load capacity. Typical values with very high-quality sub-C cells are in the range 4 mOhm to 6 mOhm.
The battery’s internal resistance is responsible for voltage losses in any battery-operated system, but it is not the only culprit: parasitic transfer resistance, caused by cables and connectors, is always present. These values can also deteriorate considerably in the course of time through oxidation at connector contact surfaces or screwed electrical connections, and under heavy current loads this additional resistance can cause considerable voltage losses at the power supply.

However, these transfer resistances generally remain unchanged relative to each other. For this reason it is always worthwhile carrying out an optimisation process in any high-current application. This involves eliminating unnecessary connectors, and using short cables of generous cross-section wherever possible. All connectors should exhibit a large contact area and be a firm, secure fit. In principle the method of measuring internal resistance is extremely simple: the battery is discharged at a high, carefully defined current, and the voltage decline compared to the unloaded state is measured. The internal resistance can then be calculated by dividing the voltage difference by the load current.

Fig. 1: Special measuring cables with spring-loaded probes

In practice the process is not quite so simple: on the one hand the voltage differences are very small - in the Millivolts range - and on the other hand the charger has to be capable of absorbing the high discharge current and the dissipated power, even when the duration of the current pulse is brief. A further difficulty is the fact that informative results can only be achieved if the voltage is measured directly at the battery terminals, otherwise voltage fall-off in the measurement cables would seriously falsify the result. To fulfil these requirements, special measurement cables (optional) are used, each wire featuring two spring-loaded probes (Fig. 1). These probes make reliable contact with the terminal caps of the battery (or other desired measurement points). The pulse of discharge current flows through the broad contacts of the measurement cables, and the second contact is used to record the measurement directly at the terminal caps of the battery.

If you wish to include the losses caused by cables and connectors in the resistance measurement, then simply position the probes at the appropriate points. The spring-loaded probes ensure reliable electrical contact at all four measurement points.

Important note:

It is in the nature of the battery Ri measurement process that it is impossible to provide reversed polarity protection. Please take care, as connecting a battery with reversed polarity can cause damage.

7 Lead-acid activator (reviver) function

The ALC 8500-2 Expert features a lead-acid activator function which can be selected when charging a lead-acid battery at channel 2. This function eliminates the problem of crystalline sulphate deposits on the plates of lead-acid batteries which have not been used for a long time, or are only ever discharged at low currents when in use.
Lead-acid batteries are designed to provide a useful life of eight to ten years or more, provided that they are maintained properly. However, in practice they very rarely last this long, and in fact the average useful life of a lead-acid battery is generally far below the theoretical maximum. A particular problem is the lead-acid battery which is only used seasonally; these regularly fail prematurely.
Many owners of motorcycles, boats and ride-on lawnmowers will be all too familiar with this problem: in the Spring the expensive battery fails the first time it is called upon, and has to be replaced. The formation of sulphate deposits is fundamental to lead-acid batteries, but the problem is particularly severe when they are slowly discharged, e.g. when they self-discharge under storage conditions; the result is a covering of crystalline sulphates all over the lead plates. The thicker the deposits become, the less energy the battery can store, and - of course - the less it can deliver. At higher ambient temperatures the rate of sulphate build-up rises considerably. Sulphate deposits are the primary reason for the premature failure of lead-acid batteries.
The Activator function can be set to switch in automatically if desired, as soon as the ALC 8500-2 Expert switches to trickle charge mode when charging a lead-acid battery
Periodic pulses of peak current prevent the build-up of sulphate deposits on the lead plates. The process also dissolves existing sulphate deposits, and the material is re-absorbed into the battery fluid in the form of active sulphur molecules.
Although the pulses of current are high, relatively little energy is removed from the battery, as the duration of the discharge current pulses, which occur every 30 seconds, is only 100 micro-seconds. The trickle charge process soon compensates for the energy discharge.
The BA function works at battery voltages of up to 15 V.
The discharge pulse is indicated by an LED on the front panel (next to the channel 2 LED); this enables you to check that the process is in action. The LED indicates the actual current flow, allowing you to monitor the operation of the circuit.

8 Data logger

The purpose of the data logger is to record complete charge / discharge processes, independently of a PC. The data logger is capable of simultaneously recording the charge / discharge process curves for all four channels, and the recorded data is retained in the charger's flash memory even when the operating voltage is switched off. Data can therefore be transferred to the PC at any subsequent time, and loaded into a spreadsheet program or similar, enabling you to analyse the "life of the battery" using almost any criteria you like.

9 USB interface

The back panel of the ALC 8500-2 Expert features a USB port which is used for communicating with a PC. The charge and discharge process curves recorded using the integral data logger can then be further processed on the computer. The easy-to-use "ChargeProfessional" PC software is ideal for storing, assessing and archiving battery data. The ALC 8500-2 Expert can also be controlled and operated entirely via the USB interface. Communication with the PC can be checked by observing the LEDs (TX, RX) located on either side of the USB port.

10 The charger in use

Thanks to the straightforward menu system and the presence of a jog dial for selecting individual menu points, the ALC 8500-2 Expert can be operated using only three buttons in addition to the mains switch. The front panel of the charger features a pair of sockets for each charge panel, to which the battery or batteries to be charged are connected.
The graphic screen and convenient menu system make it very simple to operate the charger.

10.1 Basic settings

The ALC 8500-2 Expert is switched on by pressing the mains switch located at bottom left of the front panel. First a brief initialisation phase occurs, during which the top half of the screen displays all the available segments, while the bottom (graphic) area displays the ALC 8500-2 name and the current version of the firmware. If there is a power interruption, e.g. mains failure, the charger restarts the function last carried out for each channel, and the screen displays the main window.

10.2 Main window

The main window in the top half of the screen shows detailed information on the individual charge channels.
The bottom half of the screen provides an overall view of the four charge channels available; at a glance the unambiguous symbols clearly show the function currently running on each channel. Our example (Fig. 2) shows a battery being charged at channel 1, another pack being discharged at channel 2, and a third battery being discharged at channel 3 as part of the "Refresh" function; channel 4 is currently not in use.
The available symbols and their meanings are shown in Fig. 3.
The jog dial can be used to call up detailed information on the individual charge / discharge channels in the main window; this data is then displayed in the top half of the screen.

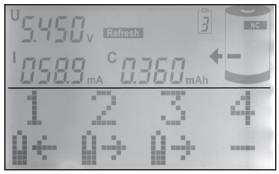


Fig. 2: Main window

The detailed information displayed is as follows: the battery technology (type) selected for the function currently running, the battery voltage, the charge current and the capacity of the selected channel. The bottom half of the screen continues to display the overall summary of all four channels.

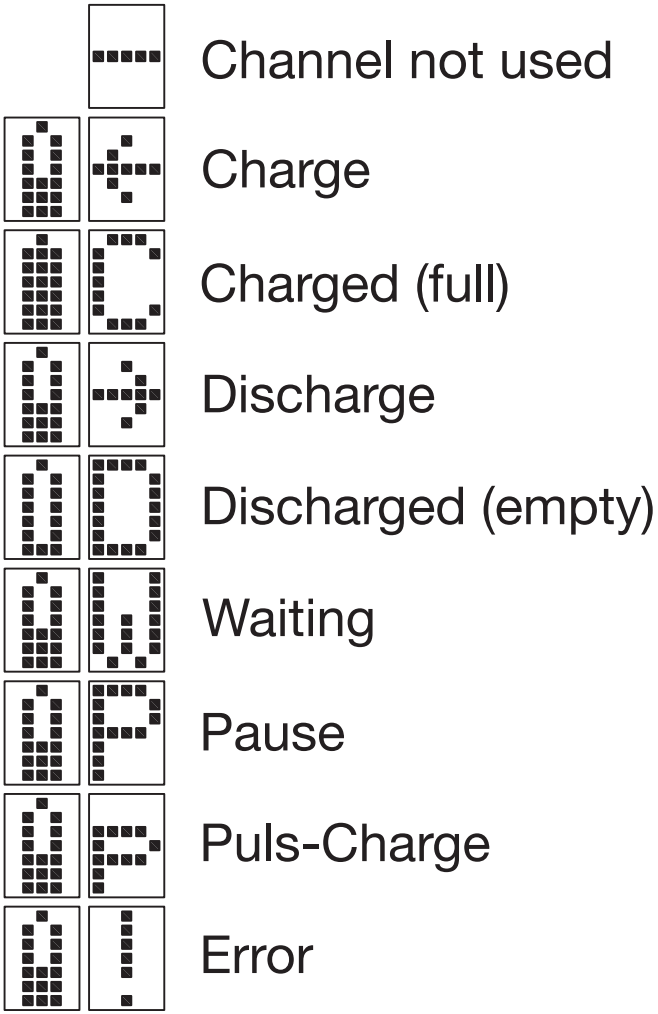


Fig. 3: The symbols available in the graphic area, and their meaning

10.3 Channel windows

In addition to the main window, four channel windows are available which can be called up using the arrow buttons under the screen. When a channel window is called up, the whole screen is available for that channel. Fig. 4 shows the functions now available using the arrow buttons. For example, if you select a channel window, you can read off the currently running function in the bottom part of the screen, or monitor the progress of the function, or check the remaining time for that process.

The jog dial is used to select the channel window display in the bottom part of the screen. Starting from the display of the currently running function, turn the jog dial one click to the right to display the programmed charge and discharge currents, and one click more to display the processing time still required and the time already elapsed (Fig. 5). If you rotate the jog dial to the left, the available information is simply displayed in the reverse sequence.

Please note that the stated times are approximate, and should only be considered as estimations, and even then only where a time prognosis is possible in any way for the selected function.

For example, an accurate time forecast for the Cycle function is impossible, as the ALC 8500-2 Expert cannot predict how many charge / discharge cycles have to be completed before the battery reaches its maximum capacity. In this case a time estimate is only displayed when the final cycle is reached. Fig. 6 shows the symbols associated with the time displays.

The bottom half of the screen displays the message “Channel not used” if you select a channel to which no battery is assigned. In this case the top half of the screen displays the channel information as in the main window.

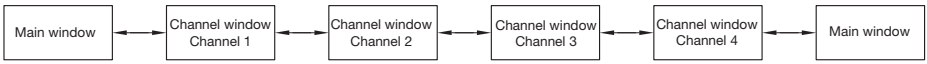


Fig. 4: Selecting the channel window using the arrow buttons below the screen

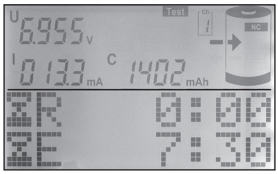
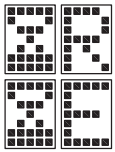


Fig. 5: Time prognosis (channel 1)



Remain (residual time)

Elapsed (elapsed time)

Fig. 6: Time prognosis symbols

10.4 Channel LEDs

Above each pair of output sockets you will find an LED indicator which displays the status of the associated charge / discharge channel. As soon as a processing program is started, the LED associated with that channel lights up.

At the conclusion of the processing program the corresponding LED flashes briefly every 1.5 seconds; this indicates that the trickle charge function is under way; this automatically follows every charge process.

If the charger automatically terminates the process for any reason, the corresponding LED flashes at a high rate to alert you to a problem.

11 Main Menu

Fig. 7: The main menu

Starting from the main window, a brief press of the “OK / Menu” button calls up the main menu (ALC 8500-2 Expert Main Menu). The lower part of the screen displays the message: “Main-Menu, Chan-Menu?” (Fig. 7).
If you wish, you can now use the arrow buttons or the jog dial to select further menus in the main menu, or press the “OK / Menu” button to move to the Channel menu where you can select the desired settings and enter battery data for the individual charge channels. If you use the arrow buttons or the jog dial to select the sub-menus, as shown in Fig. 8, you do not need to confirm your choice by pressing the “OK / Menu” button.
The “B. Resist.” menu provides access to the battery Ri measurement function of the ALC 8500-2 Expert, while the configuration of the charger and the battery to be charged can be set in the “Conf.-Menu”; selecting “Return” and pressing the “OK / Menu” button returns you to the main window.

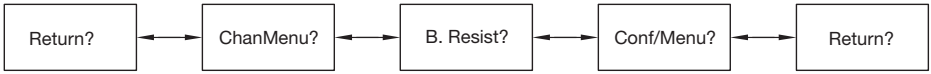


Fig. 8: Menu points in the ALC 8500-2 Expert’s Main Menu

12 Selecting the charge channel, entering data

12.1 Channel menu

Starting from Fig. 7, a brief press on the “OK / Menu” button calls up the channel select function. Confirm this, and the program asks you to select the desired channel. Display: “Select Channel”. If you prefer, you can also select the desired charge channel using the arrow buttons or the jog dial; press the “OK / Menu” button to confirm your choice. The screen display which now appears varies according to the status of the channel you have selected, i.e. whether that channel is already in use, whether you have already entered data for that battery, or whether that channel is still free and available for use. If the charge channel is free, the display window shown in Fig. 9 appears.

Fig. 9: Menu for selecting the desired battery

12.2 Battery

In the channel menu “Battery” you have access to all the batteries currently stored in the ALC 8500-2 Expert’s database. Once again you can use the jog dial or the arrow buttons to select the battery you wish to charge. Since individual names are assigned to the batteries in the database, it is particularly straightforward to select the appropriate pack. Select the battery using the arrow buttons or the jog dial, then press the “OK / Menu” button to confirm your choice; you can now directly select the function you wish to be carried out. Of course, it is also possible to charge or otherwise process batteries whose data you have not yet entered in the database. In this case you simply select “No Name” (Fig. 10) at “Sel.Bat” and confirm by pressing the “OK / Menu” button.
Since in this case the essential data relating to the battery to be processed is not known to the ALC 8500-2 Expert, the next step must be to configure the battery.

Fig. 10: Battery not in the database

12.3 Conf. Bat. (configuring batteries)

If you select “No Name” at the “Battery” stage, you now have to configure the battery to be charged. When you call up the menu, the window shown in Fig. 11 appears.

First you must confirm your selection with the “OK / Menu” button, then select the battery technology (type). Confirm your choice again, then enter the nominal capacity of the pack using the jog dial. To speed up data input you can edit the point to be changed (flashing) using the arrow buttons (Fig. 13). Confirm the selected capacity, then enter the nominal battery voltage in the same manner (Fig. 14). The actual increments available are determined by the battery technology (type) you selected earlier.

Fig. 11: Selecting the battery technology

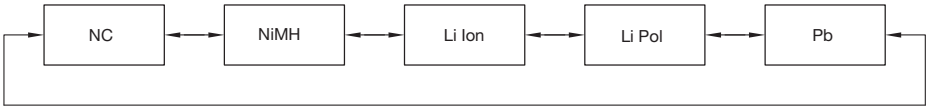


Fig. 12: Supported battery technologies

When you have entered the nominal voltage, select the charge current and the discharge current in turn; note that the program presents fixed pre-set charge / discharge rates to speed up the data entry process.

Fig. 15 shows the basic options for charge current and discharge current, while Fig. 16 shows the associated display window.

When you are selecting the charge current please note that the charge rates 2C and 4C are only available at channel 1 if the (optional) temperature sensor for super-fast charging is connected to the socket on the back panel.

For those functions which consist of several automatic charge / discharge cycles it is possible to enter a defined interval between the termination of the charge process and the start of the subsequent discharge process (Fig. 17). A brief press of the “OK / Menu” button calls up the appropriate data entry window, where the time setting is entered in the usual way using the jog dial or the arrow buttons. This completes the battery data input process.

Now press “Return” to confirm your selection - assuming that you do not wish to make corrections to any of the individual inputs - and the program returns to “Chan-Menu”, where you can now select the processing program (“Function”) you wish the charger to carry out

Fig. 13: Entering the nominal battery capacity

Fig. 14: Entering the nominal battery voltage

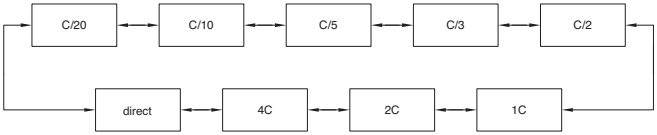


Fig. 15: The fixed pre-set charge rates of the ALC 8500-2 Expert

(Fig. 18). The battery data input process described above is not necessary if you intend to charge a battery whose data is already stored in the database. In this case you simply select the desired battery from the database, after which the program moves directly to the selection menu for the processing program (“Function”).

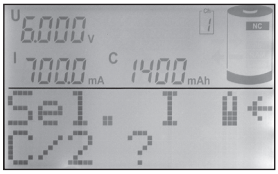


Fig. 16: Selecting the charge current

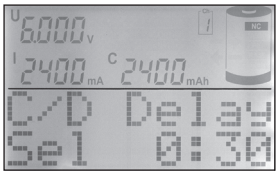


Fig. 17: Entering the charge / discharge interval

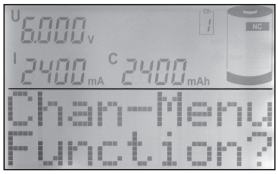


Fig. 18:
Function select menu

12.3.1 Charge rates

C/20: the battery is charged (or discharged) at a very low current corresponding to one twentieth of its nominal capacity.
C/10: at this setting the battery is charged (or discharged) at a current corresponding to one tenth of its nominal capacity. A charge factor of 1.4 is used, which means that a fully discharged NC or NiMH battery is charged for fourteen hours at this current. This charge current is often quoted as the ideal rate by many battery manufacturers, as even a fairly long overcharge at this current usually does no harm, although it hardly contributes to a long useful life of the energy storage device. Simple battery chargers, whose current is just defined by a resistor, also generally deliver a charge current of C/10.
C/5: at this setting a connected battery will be charged or discharged at a current corresponding to one fifth of the numeric value of its nominal capacity. This level of charge current is sometimes known as an accelerated charge, and shortens the charge time of a completely discharged pack to around seven hours.
C/3: the battery is charged or discharged at a current corresponding to one third of the numeric value of its nominal capacity.
C/2: the battery is charged or discharged at a current corresponding to half of the numeric value of its nominal capacity.
1 C: this is the lowest setting which is generally termed a fast charge; at this rate the battery connected is charged or discharged to about 70 to 90% of its nominal capacity within just one hour. The battery is charged at a current which corresponds to the numeric value of its nominal capacity.
2 C: this charge rate is only available if the external temperature sensor is connected. The charge rate corresponds to twice the value of the nominal battery capacity.
4 C: this charge rate is also only available if the external temperature sensor is connected. The charge rate corresponds to twice the value of the nominal battery capacity.
direct: selecting “direct” enables you to enter the charge and discharge currents directly, i.e. for charging and discharging. The value is entered in the same manner as when entering the battery’s capacity.

12.4 Function

When you call up the “Function” menu you see the display window shown in Fig. 19, with “Select Function” in the bottom half. Once again, you can use the jog dial or the arrow buttons to select the desired processing function; all the functions described in detail under 12.4.1 to 12.4.8 are available. The selected function is shown in the central area of the top half of the screen.

Fig. 19: Selecting the desired function

12.4.1 Charge

When the Charge function is selected, the ALC 8500-2 Expert charges the battery connected to it according to the set values. It is not necessary to discharge the battery before the start of the charge process, as the battery will be charged up to 100% of its actual capacity regardless of any residual charge which may be present. Note that new batteries are sometimes capable of accepting more energy than their stated nominal capacity, whereas older batteries will generally fall short of this.

When you have entered the battery data and selected the “Charge” function, press the “Start” button to initiate the charge process. As long as the connected battery is on charge, the main window will display the corresponding symbols. When the battery reaches its maximum effective capacity, the screen displays the “Charged” symbol, and a text message that the charge process is concluded appears in the channel window. The charged-in capacity can be read off in the top half of the screen.

The charger now switches over to trickle charge of unlimited duration, designed to compensate for losses due to the self-discharge process. This means that it is permissible to leave the pack connected to the (switched-on) charger for an indefinite period.

12.4.2 Discharge

When this function is selected, the battery connected to the ALC 8500-2 Expert is discharged down to the final discharge voltage appropriate to the pack; the capacity removed from the battery is displayed on the graphic screen.

12.4.3 Discharge / Charge

First the ALC 8500-2 Expert initiates a discharge process in order to pre-discharge the battery connected to it. When the battery has reached the appropriate final discharge voltage, the charge process starts automatically at the programmed charge current. We recommend that you always pre-discharge your NC batteries before charging them, as the process reliably eliminates and prevents the memory effect.

When the charge process is concluded, the charger again switches to the trickle charge function.

12.4.4 Test

The Test function is designed for measuring battery capacity. Battery capacity should generally be measured under defined nominal conditions, as the quantity of energy which can be removed from a pack varies according to a number of factors, including the discharge current employed. It is often the case with NC cells that the stated nominal capacity applies to a discharge current corresponding to 20% of the battery’s nominal capacity (C/5). For example, a 1 Ah battery would be discharged at a current of 200 mA in order to measure its capacity.

The first step in determining the capacity of the pack is to charge it completely. A full discharge process is then carried out under the previously defined nominal conditions; the capacity removed from the pack is measured continuously until its voltage falls to the final discharge value.

When this function has been completed, the battery is recharged with automatic transition to trickle charge.

12.4.5 Refresh

The Refresh function of the ALC 8500-2 Expert is primarily intended for use with defective or damaged batteries, most of which can be re-used after subjecting them to this program. This applies in particular to deep-discharged batteries, and packs stored for a long time, but also to batteries which exhibit a cell short, all of which are often usable again after this process has been completed.
The program starts by checking whether a voltage is present in the battery or not; it then discharges it for a while before subjecting it to powerful pulses of current. If you have a battery with a shorted cell, the “Refresh” function is best carried out at channel 1 or 2, as higher current pulses are available at these outputs. After this the ALC 8500-2 Expert automatically carries out three charge / discharge cycles.
The first of these charge cycles is carried out at a current corresponding to 10% of the previously entered nominal capacity. Since the charge process of a battery previously damaged in this way often fails to exhibit the typical curve, the Delta-V cut-off point detection is switched off for the first charge cycle. Since a timer-controlled charge now takes place, it is clearly important that you enter the correct nominal capacity beforehand.
The two subsequent charge cycles are carried out with the charge / discharge currents corresponding to 50% of the battery’s nominal capacity, with the Delta-V cut-off point detection re-activated.
At the conclusion of the last charge process the battery is fed a trickle current to keep it in the fully charged state.

12.4.6 Cycle

Batteries which have not been used for a long period are generally incapable of delivering their full capacity. The primary purpose of the “Cycle” (regeneration) function is to revive batteries in this state. The program automatically repeats the charge / discharge cycle using the pre-set charge and discharge currents until it detects no increase in capacity. When the cycle program has finished, the screen displays the last value for charged-in capacity, and then switches over automatically to a trickle charge which compensates for energy loss through self-discharge.

12.4.7 Forming (balancing)

New batteries are not capable of providing their full performance from the very first charge cycle. For this reason the ALC 8500-2 Expert can be set to give a new pack a configurable number of initial charge / discharge cycles in order to bring it up to maximum capacity. The basic rule is that batteries are formed, or balanced, by charging them at reduced current; the charge rates available are those shown in Fig. 20. After the second charge process the program switches from the forming current to the set charge and discharge currents, but with a maximum of 1C.

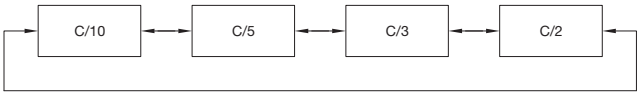


Fig. 20: Selecting the forming current on the ALC 8500-2 Expert

12.4.8 Maintain

The “Maintain” function is intended for any battery which is not to be used for a long period, but whose full performance must be available when required. This function gives NC and NiMH batteries a full charge, after which a trickle charge is applied to compensate for capacity losses caused by self-discharging; this is the same process as a normal charge. However, the “Maintain” function automatically discharges the pack to the final discharge voltage once a week. In the case of lead-acid batteries 10% of the nominal capacity is removed from it once a week, and then charged back in again. Used in conjunction with the lead-acid activator function, this program constitutes a highly efficient means of preventing hardening and passivation of the lead plates. Naturally, the pre-set final discharge voltage is taken into account during the discharge process.

After you have selected the processing function you wish to use, all the essential parameters for processing the battery pack are concluded, and are displayed on the screen when you confirm your selection by pressing the “OK / Menu” button briefly. Now press the “OK / Menu” button again to initiate the process. The program returns to the main menu; confirm once more with “Return”, and the screen displays the main window again.
During the process the top half of the screen shows the voltage, current and battery capacity which can be read off directly; the measured values are constantly updated while the processing progresses. The screen also shows all the important status information for the corresponding charge channel. If you wish to halt the program at any time for any reason, simply select the channel in the “Chan-Menu” and select “Stop”.

13. B. Resist. (Ri measurement function)

Selecting the sub-menu “B. Resist.” from the main menu takes you to the ALC 8500-2 Expert’s internal battery resistance measurement function (Fig. 21). Press the “OK / Menu” button briefly to move to the display window shown in Fig. 22.

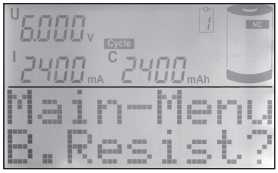


Fig. 21: Battery Ri measurement function

In principle the method of measuring internal resistance is extremely simple: the battery is discharged at a high, carefully defined current, and the voltage decline compared to the unloaded state is measured. The internal resistance can now be calculated by dividing the voltage difference by the load current.
As we are dealing with very small resistances here, the load current on the battery needs to be as high as possible. However, a continuous high current would generate a great deal of waste heat, and would also discharge the battery to a significant extent. These problems can be avoided by using pulses of current to measure the internal resistance. The current pulses with the ALC 8500-2 Expert are variable within the range 1 A to 10 A, although we recommend selecting as high a current as possible, otherwise - bearing in mind the typically low internal resistance of these batteries - the voltage drop will be extremely small. Low current pulses only make sense with batteries which are unable to cope with high peak loads.

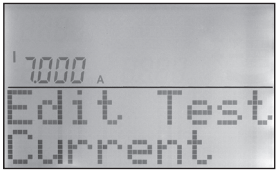


Fig. 22: Setting the pulsed current for battery Ri measurement

Informative results can only be achieved if the voltage is measured directly at the battery terminals, otherwise voltage fall-off in the measurement cables would seriously falsify the result. To fulfil these requirements, special measurement cables are used, each wire featuring two spring-loaded probes (see Fig. 1). These probes make reliable contact with the terminal caps of the battery (or other desired measurement points). The pulse of discharge current flows through the broad contacts of the measurement cables, and the second contact is used to record the measurement directly at the terminal caps of the battery.
If you wish to include the losses caused by cables and connectors in the resistance measurement, then simply position the probes at the appropriate points. The spring-loaded probes ensure reliable electrical contact at all four measurement points.
Important: when carrying out the measurement the spring contacts must always be pushed hard against the contact surfaces of the battery, i.e. as far as they will go. When carrying out comparative measurements at different cells it is essential to use identical contact surfaces. Even welded solder tags have a considerable influence on the measured result. Typical values for individual very good sub-C cells are in the range 4 mOhm to 6 mOhm.
The battery’s internal resistance is responsible for voltage losses in any battery-operated system, but it is not the only culprit: parasitic transfer resistance, caused by cables and connectors, can have a considerable influence. In any high-current applications all connectors should exhibit a large contact area and be a firm, secure fit.

The higher the internal resistance of the battery, the worse the voltage curve under load conditions, and the more dissipated power is converted into heat within the cell and at the parasitic transfer resistance points. At high currents parasitic resistances in the mOhm range can certainly cause considerable voltage losses at the motor or other consumer.

The Ri function can also be used as a straightforward means of measuring internal resistance in the system as a whole. First set the pulse current, then press the “OK / Menu” button again to move to the main Ri measurement function window. Confirming again initiates the measurement function (Fig. 23).

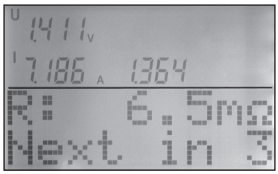


Fig. 23: Main Ri measurement function window

When you start this function, ten values are recorded in sequence, at five-second intervals, and the results are displayed on the screen: the measured internal resistance is shown in the lower graphic area of the screen, while the top half of the screen displays the battery voltage in the zero-load state, the voltage under load, and the pulse current which is actually flowing.

The Ri measurement function concludes automatically, after which the last recorded measured values continue to be displayed on the screen. If you wish to record a further series of ten measured values under the same conditions, simply press the “OK / Menu” button once more.

When Ri values are actively being measured, the bottom section of the screen indicates this (countdown to the next measured value).

If you wish to change the pulse current for the internal battery resistance measurement process, simply press the “←” button briefly: you can then set the desired current (in increments of 500 mA) using the jog dial, and confirm your selection by pressing the “OK / Menu” button. When you initiate the process again, the internal resistance will be measured using the new set current.

Press the “→” button to conclude the battery Ri measurement function; confirm your selection by pressing “OK / Menu” again, and you are returned to the “Main Menu”.

Note: optional measuring cable required.

14. Conf. menu

The configuration menu is a further sub-menu (Fig. 24) available from the Main Menu. This is where you access the menus for configuring the ALC 8500-2 Expert and the batteries stored in its internal database, as described in the next section.
To reach the configuration menu select the “Conf.-Menu” sub-menu from the “Main Menu”, and confirm by pressing “OK / Menu”. The Conf.-Menu now offers the menu points listed in Fig. 25:

Fig. 24: Configuration menu

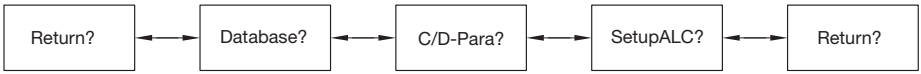


Fig. 25: Menu points in the “Conf.-Menu”

14.1 Database

A particularly convenient feature of the ALC 8500-2 Expert is the ability to store the nominal data and charge parameters of particular batteries (those which are to be processed regularly) in the machine’s internal database. In total the database can store data for up to forty batteries of all types, and it is also possible to assign a name (up to nine characters) to each battery if you wish. The menu points available in the “Database” menu are shown in Fig. 26.

Fig. 26: Menu points in the” Database” menu

14.1.1 New Bat.

The “New Bat.” menu is used to edit and store data for new batteries in the database, i.e. batteries which you have not yet stored. Press the “OK / Menu” button to move to the menu, and confirm the “Sel. Name” menu point. You can now enter a name of your choice with a maximum of nine characters. This is the procedure: select the character using the jog dial, and select the position with the arrow buttons (Fig. 27). Press the “OK / Menu” button to confirm your selection after you have edited the name.
The next step is to select and confirm the battery type, then enter the nominal battery capacity, nominal voltage, desired charge current, desired discharge current and the interval which is to elapse between charge / discharge cycles, using the same procedure.

Fig. 27: Editing a battery name

14.1.2 Edit Bat.

This function allows you to edit the battery data already stored in the database. Data is entered in exactly the same way as when storing new battery data. The process is only complete when the screen automatically displays “Return” (alternatively you can switch directly to this point by turning the jog dial to the right); the data is now stored. If you do not complete the input process, the battery is erased from the database.

14.1.3 Del. Bat.

This function is used to erase batteries which are stored in the database but no longer required. Call up the database, select the battery to be erased using the jog dial or the arrow buttons, then confirm your selection (“OK / Menu” button) to erase the battery from the database.

14.1.4 Return

To return to the Conf. Menu, press “Return”, then confirm by pressing the “OK / Menu” button.

14.2 C/D-Para

The charge / discharge parameters are configured in the “C/D-Para” menu (Fig. 28). In this menu you can set the final discharge voltages for the various battery technologies, and also select the maximum number of charge / discharge cycles for the “Cycle” and “Form” functions. It is only possible to alter the individual parameters within the permissible limits, as this avoids a safety risk if incorrect parameters are entered.

Fig. 28: Configuring charge / discharge parameters

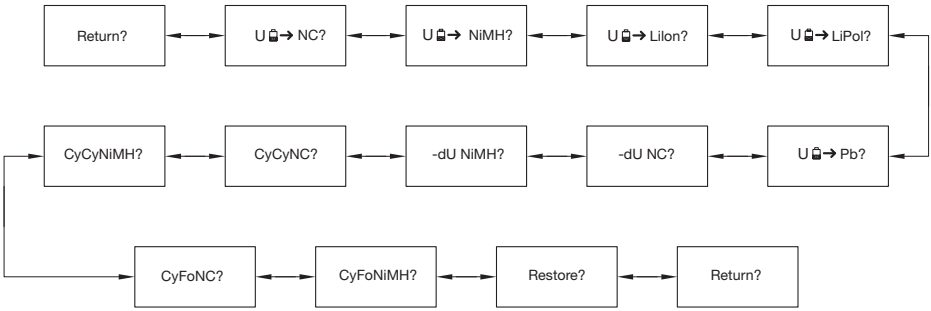


Fig. 29: Menu points in the “C/D-Para” menu

Fig. 29 shows the menu points available in the “C/D-Para” menu, which are once again selected using the jog dial or the arrow buttons. Confirm your choice with the “OK / Menu” button, and you can then alter the settings within the available limits. The following parameters can be modified:

U→ **NC**
Final discharge voltage for NC batteries in the range 0.8 V to 1.1 V per cell

U→ **NiMH**
Final discharge voltage for NiMH batteries in the range 0.8 V to 1.1 V per cell

U→ **LiIon**
Final discharge voltage for Lithium-Ion batteries in the range 2.70 V to 3.10 V per cell

U→ **LiPol**
Final discharge voltage for Lithium-Polymer batteries in the range 2.70 V to 3.20 V per cell

U→ **Pb**
Final discharge voltage for lead-acid batteries in the range 1.70 V to 2.00 V per cell

-ΔU NC
Charge cut-off detection for NC batteries, variable in the range 0.15% to 1.00% **-ΔU**

-ΔU NiMH
Charge cut-off detection for NiMH batteries, variable in the range 0.10% to 0.40% **-ΔU**

CyCy NC
Maximum cycle count for NC batteries in the “Cycle” function; variable in the range 2 to 20 cycles

CyCy NiMH
Maximum cycle count for NiMH batteries in the “Cycle” function; variable in the range 2 to 20 cycles
CyFo NC
Maximum cycle count for NC batteries in the “Form” function; variable in the range 2 to 20 cycles
CyFo NiMH
Maximum cycle count for NiMH batteries in the “Form” function; variable in the range 2 to 20 cycles
Restore
If you select “Restore” and confirm it by pressing the “OK / Menu” button, all charge / discharge parameters are returned to the standard default values.
Return
“Setup ALC” is a further sub-menu within the configuration menu of the ALC 8500-2 Expert. Confirm your selection with the “OK / Menu” button, and the menu points shown in Fig. 30 are available.

14.3 Setup ALC

“Setup ALC” is a further sub-menu within the ALC 8500-2 Expert’s Configuration menu. Confirm your selection with the “OK / Menu” button, and the menu points listed in Fig. 30 are available:

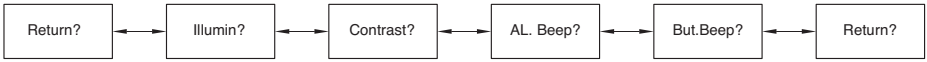


Fig. 30: Menu points in the “Setup ALC” menu

14.3.1 Illuminat.

In this menu (Fig. 31) you can set the duration of the display backlighting in active mode after the last operation of the controls (buttons, jog dial). The times available are: 1 minute, 5 minutes, 10 minutes, 30 minutes and 60 minutes. It is also possible to switch the backlighting on or off permanently.

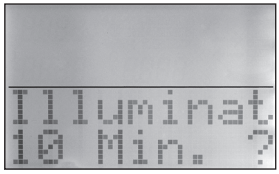


Fig. 31: Setting the time for screen backlighting

14.3.2 Contrast

Calling up this menu enables you to set the screen contrast to any of sixteen values, and store your preference (see Fig. 32).

14.3.3 Al. Beep

The ALC 8500-2 Expert is fitted with an audible sounder which emits various alarm signals if limit values are exceeded, if an error occurs and after the conclusion of various functions. At this menu point you can switch the sounder function on and off.

14.3.4 But. Beep

When the “Button Beep” function is active, the charger emits a brief audible beep every time you press a button or turn the jog dial (incremental control).

Fig. 32: Setting the screen contrast

15 Display of charged-in / discharged capacity

During the charge process the charged-in capacity is continuously updated and displayed directly on the screen. During the discharge process the same applies to the capacity discharged from the battery. After the conclusion of the process the capacity of the last completed action can be read off on the screen; with the exception of the Discharge process this will always be the charged-in capacity.
For example, to check the capacity discharged from the battery during the "Test" function, select the desired charge channel and halt the function at the "Chan-Menu".
The graphic area of the screen now displays a "Resume?" message. Confirm this by pressing the "OK / Menu" button, and the screen displays the capacity discharged from the battery (Fig. 33).

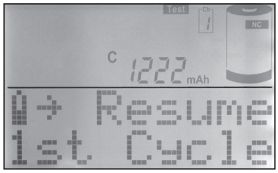


Fig. 33: Display of discharged capacity

In the "Cycle" and "Form" functions the charger stores the measured capacities from the first, second and last cycles, and these can then be called up using the jog dial. It is also possible to check the already stored capacity values while the process is running: select the desired channel, and "Stop?" is displayed in the Channel menu; now press the right-arrow button or turn the jog dial to the right by one click. The screen displays the message "Resume?"; press the "OK / Menu" button to confirm, and the screen will display the capacity discharged from the battery. You can now also check the other discharged capacities in the "Cycle" and "Form" functions using the jog dial.

16 Reading out the data logger on-screen

The "ChargeProfessional" PC software is available as a convenient means of reading out the data logger. All the data stored in the ALC 8500-2 Expert's flash data memory can also be displayed directly on the screen. When a process is concluded, the "DF-Read?" (Dataflash read) function is available in addition to "Resume?"; this is used to display the discharged capacities.
Press the "OK / Menu" button to confirm your choice, and the individual measured values are displayed: the upper part of the screen shows the battery voltage, the current and the capacity recorded up to that moment. Use the jog dial to cycle through the individual measured values, or use the arrow buttons to leaf through in increments of one hundred (Fig. 34). During the intervals of discharge / charge processes data continues to be recorded at 5-second intervals. During these intervals no current values are present, and this is indicated with a letter "P" (pause). Any missed measured values are always marked with a letter "M".

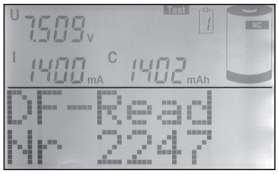


Fig. 34: Reading out the flash data memory

If you leave the menu, the stored values are no longer available on-screen. The data logger can be read out via the USB interface, but only as long as no changes are made on the appropriate charge channel. The flash data memory is erased as soon as changes are made to that charge channel, or you initiate a new process.

17 Reading out the data logger via the USB interface

The contents of the data logger can be transferred to a PC via the USB port located on the back panel. This is carried out using the "ChargeProfessional" software, as mentioned earlier.

When a process is concluded and the function stopped, the data in the flash memory is retained indefinitely even when the device is switched off, but only until such time as you make changes to the corresponding charge channel. However, for data retention it is essential that the function be stopped before you switch the charger off, unless the process has already reached the “trickle charge” state. If this is not the case, the process would re-start next time mains power is restored or the unit is switched on, and this would cause the previously stored data to be lost (behaviour as in the case of mains failure).
At the conclusion of the function, or when it reaches the “trickle charge” state, it is safe to disconnect the charger and carry it to another location for reading out the data logger (for example, to a PC in another room).

18 Supplementary notes

18.1 Reversed polarity protection
If a battery is connected to the charge / discharge outputs with reversed polarity, this will usually blow the fuse for that output stage. The fuse must then be replaced, once you have disconnected the reversed-polarity battery from the output. If the current delivered by the battery is not enough to blow the fuse, the ALC 8500-2 Expert emits a continuous audible alarm until such time as you disconnect the battery.

18.2 Discharging single cells
When individual cells are discharged at a high current, the maximum current varies according to the extent to which the voltage of the cell (and therefore also the voltage of the charge channel) falls during the discharge process. However, this does not result in a capacity error, as the actual measured current is used as the basis for calculating the cell’s capacity.
In fact the screen always displays the battery voltage under zero-current conditions; this is always significantly higher than its voltage under load.

18.3 Automatic cooling fan
The unit contains a temperature-controlled fan which provides accelerated air circulation round the power electronics for even cooling when multiple charge channels are in use simultaneously running high-current processes.
The fan is switched on and off automatically, and cannot be controlled manually.

18.4 Output stage fuses
The ALC 8500-2 Expert’s charge / discharge output stages are protected by glass cartridge fuses which are accessible on the back panel without having to open the case.
Important: if a fuse blows, it must be replaced by a fuse of exactly the same rating and type. Incorrect fuses offer no protection, and if a fault occurs the result could be serious damage to the charger and the batteries connected to it.

18.5 Mains fuse
The mains fuse is also available on the back panel and can be replaced without opening the case.
Important: the mains fuse must never be by-passed or replaced with a fuse of a higher rating.

18.6 Temperature sensor
The external temperature sensor is used to monitor the temperature of the battery when it is being charged at channel 1 using the “Super-fast charge” function. For the system to work properly it is vital that the sensor makes good thermal contact with the battery!

18.7 Error messages

The ALC 8500-2 Expert incorporates a comprehensive set of safety functions, and automatically halts the current process if any important parameter strays outside the permissible range.
After an automatic forced shut-down the screen displays an exclamation mark (“!”) in the overall view (main window).
If this happens, use the arrow buttons to switch to the appropriate charge channel, and you will see an indication of the reason for the enforced shut-down in the bottom half of the screen. The meaning of the on-screen messages is as follows:

Trans.hot: The temperature of the mains transformer is too high; all charge channels are switched off.

Heats.hot: The temperature of the heatsink is too high; all charge / discharge channels are switched off.

Bat.hot: The external temperature sensor has registered a battery temperature outside the permissible range.

Overvolt: The battery voltage is too high, or has been set incorrectly.
Alternatively the connection between the charger and the battery may have been interrupted.

Overcap: The dU detect circuit has not tripped even though a charge factor of 1.6 has been reached. This may mean that you have entered the wrong nominal battery capacity. If you set too low a charge current with an NC or NiMH battery, it is likely that no detectable dU effect will be generated. However, “overcharging” the pack at such low currents usually does no harm.

Low Volt.: The charger cannot detect an adequate battery voltage. It may be that you have set the nominal battery voltage incorrectly, or the battery maybe defective.

I=0 Fuse?: The fuse of the corresponding charge / discharge channel has blown.

19 Maintenance, care

Always disconnect the machine from the mains supply before cleaning it, using only a soft dry cloth. If the case gets very dirty the cloth can be slightly moistened. Remove all traces of moisture with a dry cloth before re-using the charger.

Do not immerse the ALC 8500-2 Expert in water!

Do not use solvent-based cleaning agents to clean the charger.

If a fault occurs with the charger, do not open the case, as it contains no parts which you can repair or replace yourself. Send the complete unit to our Service Department for repair.
Do not leave batteries connected to the charger for a long period when it is switched off, as they could suffer damage through being discharged. If a battery leaks, do not touch it with your bare hands; use rubber gloves or similar. **Never allow the chemicals to contact your bare skin!**
If the chemicals accidentally get on your skin, wash the affected area immediately with plenty of running water. The same applies if the chemicals get on your clothing.

20 Specification

No. of charge channels: 4
Nominal battery voltage: ..... Channels 1 + 2 max. 24 V, channels 3 + 4 max. 12 V
Charge current: ..... Channels 1 + 2 max. 5 A (charge power max. 40 VA total)
Channels 3 + 4 max. 1 A total
Discharge current: ..... Channels 1 + 2 max. 5 A, channels 3 + 4 max. 1 A
Supported battery technologies: ..... NC, NiMH, Pb, Li-Ion, Li-Po
Charge termination detection: ..... NC and NiMH: negative voltage difference
Lead-acid, Lead-gel, Li-Ion and Li-Po: current / voltage curve
Displays: ..... Graphic screen, power indicator, channel LEDs, lead-acid activator indicator
Controls: ..... Buttons, jog dial
Special functions: ..... Battery Ri measurement, lead-acid activator
Socket for external temperature sensor,
Integral data logger
Interface: ..... USB
Software: ..... Flash memory for updates and upgrades
Power supply: ..... 230 V / 50 Hz
Dimensions (W x H x D): ..... 315 x 204 x 109 mm

This symbol means that electrical and electronic devices, when they reach the end of their useful life, must be disposed of separately from the household waste. Take your unwanted equipment to your local communal waste collection point or recycling centre. This applies to all countries of the European Union, and other European countries which have separate waste collection systems.