

**Dear fellow modeller,**

Your choice of the **ecolader** provides you with a micro-computer controlled High-Tech charger and discharger developed and built in Germany.

As market leaders in the field of automatic rapid chargers for model aircraft, our aim with this device was to produce a high-quality charger for the model car driver with all the functionality you need.

Thanks to the charger's facility to charge at all three outputs using default settings, you do not need to operate any controls on the unit - apart from selecting a charge or discharge program.

As a "pro" driver you will appreciate the ecolader's comprehensive adjustment facilities, all aimed at charging the maximum possible quantity of energy into your packs by means of a range of charging techniques, including the optimised Schulze Refresh process for revitalising tired batteries.

Combination programs (charge/discharge or discharge/charge) are provided to help you maintain, balance and measure the condition of your packs.

The **ecolader select** can be used with a supplementary resistance to increase the already very high discharge current still further. Batteries are measured using a precision 12-bit A/D converter, and battery data can be transferred to the PC for analysis and archiving.

Section	Subject	Page
1	Warnings . . . . .	2
2	How to obtain reliable, trouble-free operation . . . . .	3
3	Fitting the CE tube . . . . .	4
4	Terminology . . . . .	4
5	Useful information on battery care . . . . .	5
6	Basic operations . . . . .	6
7	Connecting the unit, setting the standard values . . . . .	8
8	Changing the default characteristics (summary table) . . . . .	10
	8.1-8.24 Description of charger characteristics . . . . .	10-27
9	Monitor displays on the LCD screen . . . . .	27
10	Auxiliary sockets on the side panels . . . . .	28
11	Data interface . . . . .	30
12	winsoft PC analysis program . . . . .	30
13	Legal matters . . . . .	31
14	Specification, auxiliary socket pin-outs, data formats . . . . .	32
15	Error messages and their causes . . . . .	34
16	Fault-finding, fault correction . . . . .	35
17	Service questionnaire . . . . .	36



## 1 Warnings

**Injury hazard!** Watch out for sharp corners and edges when handling the charger (heat-sink).

The CE symbol is not an excuse to handle the charger, the power supply or the batteries connected to it carelessly.

Before you connect the unit to a 12 V car battery: switch off the vehicle's engine. The charger is only approved for use with a stationary vehicle whose engine is stopped.

The unit must only be operated with the original, unmodified connecting cables.

Avoid short-circuits between the charge outputs and the car bodywork. To be on the safe side, place the charger on the ground.

The charge cables and charge outputs must never be connected to each other or shorted in any way; the result would inevitably be damage to the unit and/or the battery. To avoid short-circuits between the banana plugs on the charge cable, always connect the charge cable to the charger first, and only then connect the battery. Keep to the reverse order when disconnecting. Our safety charge cables eliminate the hazard of exposed banana plug contacts, as they are protected by a spring-loaded insulating sleeve.

To meet CE requirements the length of the charge cable must not exceed 20 cm.

The temperature of the **ecolader's** heat-sink can easily reach 100°C when running. Take care not to touch it to avoid burns!

There is always a risk of explosion when Ni-Cd batteries are being rapid-charged. For this reason it is important not to leave the charger unsupervised during rapid-charging.

Place the unit and the batteries connected to it on a non-flammable, heatproof and electrically non-conducting surface when in use.

Keep inflammable and volatile substances and objects well clear of the charging station when the system is in use.

As a precaution we recommend that you remove batteries from the model for charging.

When charging internal transmitter batteries the maximum permissible charge current (dictated by the transmitter circuit board) must be observed by setting the current manually. The usual rate is 0.5 - 2 A; see radio manufacturer's specification.

Note that fully-charged cells become very hot when "peaked" using the delay setting on the charge termination circuit.

Never attempt to use the **ecolader** with a car battery when the battery itself is on charge on a battery charger. This will damage the charger! Use a stabilised 13.8 V DC voltage source which is current overload protected.

Protect the **ecolader** from damp, water, shock and pressure loads.

Do not continue to use the charger if it exhibits a fault, or if the screen displays an error message.

Charging fewer than four cells:

The peak detection termination circuit may trip prematurely, with a delay, or even not at all! Reason: the "kink" in the voltage curve of high-capacity cells when the charge current is low and the number of cells small is very slight.

If you use a low number of cells the charger will not reach the normal maximum charge current to prevent overheat.

The following types of battery / pack / cell must **not** be connected to the unit:

- Packs consisting of different types of cell
- Mixtures of old and new cells, or cells of different makes
- Non-rechargeable batteries (i.e. dry cells)
- Lithium-Ion batteries
- Batteries which are not expressly stated by the manufacturer to be suitable for the high charge currents which this unit supplies
- Faulty or damaged single cells
- Fully charged or hot batteries
- Batteries with an integral charge or cut-off circuit
- Batteries which are an integral part of a device, or are electrically connected to other components



## 2 How to obtain reliable, trouble-free operation

Be sure to protect the charger from direct sunshine, dust, damp and rain. If the unit should get wet, let it dry out thoroughly and have it checked and cleaned before re-use.

The case openings must never be obstructed or sealed.

The charger produces considerable heat when working - up to 100°C at the heat-sink; don't burn yourself! - and it is important to provide an effective means of dissipating the heat. This applies in particular after a high-rate charge of a pack of few cells, or a high-current discharge process, when the unit should be allowed plenty of time to cool down before re-use.

Check the charger regularly - cables, connectors, case and screen - for possible damage and intermittent contacts.

Keep the charge leads (between charger and pack) as short as possible. CE directives require cables no longer than 20 cm. The cables attached to the battery must also be as short as possible, and the conductor cross-section should be no less than 2.5 mm<sup>2</sup> - even for a receiver battery!

Use high-quality connectors exclusively (gold-contact types) at both ends of the charge cable, and run each cable through one of the ferrite tubes (CE tube) supplied with the charger. These tubes are essential in order to meet CE requirements (see Section 3).

Twist cables together to avoid interference.

Always keep to the battery manufacturer's recommended charge currents and times. You should only charge packs which are expressly stated to be suitable for rapid-charging.

In theory the unit can be powered by a stabilised mains power supply, but we cannot recommend this generally.

If you insist on using the charger in this way, you must check carefully to ensure that your combination of charger / power supply works correctly under all circumstances.

Many transmitters feature a reverse-flow diode which must be by-passed if you wish to rapid-charge the battery. Be sure to read the RC system instructions before you try this.

Make it a habit to check that the charge quantity indicated is roughly what you expected after the unit has switched off automatically. This is the easy and reliable way to notice when and if the unit detects a "battery full" state erroneously. Premature charge termination is most likely with deep-discharged packs, and/or packs of few cells (carry out a test charge first!), although particular cell types tend to cause problems.

**Caution:** if you fail to notice that a battery is not fully charged, using that pack in a model aircraft could easily cause a crash!

The sequence of letters "a", "b"... indicates the probability of a full charge, but the "full" message does not necessarily follow them. The letters sequence often appears at the start of the charge, especially if deep-discharged cells are in use.

Cells to be recharged together must be connected by soldering if the fully automatic programs are to function correctly. Don't use battery boxes with spring contacts!

The **ecolader** only sets the charge current calculated as optimum for the battery if that current does not exceed any of the permissible parameters for the charger.

Results with Ni-MH batteries are good provided that you set the charge current manually, and keep to charge currents of 1 C or less.

The unit needs about 10 minutes time to detect the correct number of cells of a deeply discharged pack.

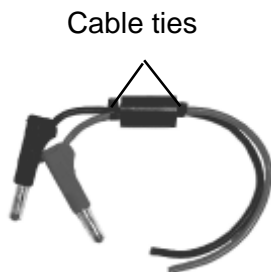
If the voltage at battery socket 3 is < 0.5 V the charger assumes reversed polarity.



### 3 Fitting the CE tube

#### Requirements:

- The conductor cross-section of the charge cables should be 2.5 mm<sup>2</sup>.
  - One insulator should be coloured red (positive terminal +) and the other black (negative terminal -).
  - The charge cable should be no longer than 20 cm (including the length of cable attached to the battery!) in order to meet CE requirements.
1. Solder a banana plug to each cable. You can avoid short-circuits by using our special safety banana plugs with spring-loaded insulators.
  2. Tie the two cables together about 4 cm from the banana plugs using one of the cable ties supplied.
  3. Slip the EMF tube supplied onto the free end of the charge cable.
  4. Tie the two cables together immediately after the tube using the second cable tie (see illustration).



5. Twist the cables together and/or hold them together with pieces of heat-shrink sleeving.
6. Now solder the battery connector to the exposed wire ends. Don't forget to fit the heat-shrink sleeves on the wires beforehand.

A factory-made charge cable complete with safety banana plugs and CE tube is available from us under **CE-kab-i6** (see illustration).

The sensor cable for the ecolader select is made up in the same way using a tube and two cable ties, but the tube should be located up to 5 cm from the 10-pin socket.

### 4 Terminology

**Final discharge voltage:** The final discharge voltage represents the discharge limit for the pack.

The voltage is determined by the chemical composition of the battery. Below this voltage the cells enter the deep-discharge zone, where there is a danger of individual cells suffering reversed polarity and possible permanent damage.

**Balancing:** Alternating discharge / charge cycles, repeated where necessary, aimed at restoring the full (nominal) capacity. This process is especially effective after a long period of non-use (e.g. after purchase, or after several weeks' lay-off), or in an attempt to eliminate the memory effect (see below). Balancing has the effect of converting a coarse crystalline structure inside the cell (low capacity) into a fine crystalline one (high capacity).

**Memory effect:** this term is used for the effect on battery capacity (shorter motor runs) of repeated partial charges/discharges. This phenomenon can be eliminated by carrying out several balancing processes, in which the packs are taken down to their final discharge voltage, or even slowly reduced to a cell voltage of 0 V by means of resistances across each cell separately.

**Final charge voltage:** the voltage which represents the charge (or capacity) limit of the battery. At this point the charger switches from a high current to a low maintenance rate (trickle charge). Further rapid-charging at this point would lead to overheating and permanent cell damage.

**Power-On (reset):** State of *ecolader* when just connected to the car battery.

**Ready message:** unit ready to carry out your selected program (batteries not yet connected).

**C: Coulomb / Capacity:** unit of measurement for the quantity of charge; in conjunction with the charge current information this unit is used to calculate the recommended charge current of a battery of a particular capacity. Example: if the charge or discharge current of a 500 mAh pack is 50 mA, we speak of a charge or discharge rate of one tenth C (C/10 or 1/10 C).

**A, mA:** unit of measurement for the charge or discharge current. 1A = 1000mA (A=Ampere, mA=Milliampere)

**Ah, mAh:** unit of measurement for the capacity of a battery (Amps multiplied by time unit; h = hour). If a battery is charged for one hour at a current of 2 A, a total of 2 Ah of energy has been fed into it. The battery has been supplied the same quantity of energy (2 Ah) if it is charged for 4 hours at 0.5 A, or 15 minutes (= 1/4 hour) at 8 A.



## 5 Useful information about battery care

### 5.1 General information:

A cold cell cannot absorb so much current as a warm one, and for this reason you can expect seasonal differences in charge behaviour if you use the fully automatic charge current calculation. In Winter your packs will not accept as much charge as in Summer.

The lower the internal resistance of the battery, the higher the charger can push the charge rate. **Note that a charger which calculates the charge rate automatically also takes into account the resistance of the charge cables. So: use short cables of large conductor cross-section (even for receiver battery cables). Do not charge via a switch or switch harness!**

### 5.2 Nickel-Cadmium batteries:

Selecting the charge current (manual selection):

Charge current =  $2 \times C$  (C = nominal battery capacity)

If a pack is not regularly maintained, or is brand-new, it can often take several discharge/charge cycles for it to reach a completely balanced condition.

As a general rule you can calculate a suitable discharge current for an accurate measurement of battery capacity as follows:

Discharge current =  $1/10 C$  (C = nominal battery capacity)

In practice however, higher discharge currents can be tolerated, depending on the degree of accuracy you require.

Our automatic method of calculating charge current is the subject of a patent application, and provides optimum protection to your Ni-Cd packs against damage. The reduced charge current towards the end of the process ensures maximum energy absorption and minimal temperature rise, as can easily be ascertained in comparison with conventional constant current charging procedures.

Note that the lower charge current which is applied with 1-5 cells, combined with the small voltage "kink" with high-capacity packs, may lead to difficulties in detecting the Peak when such packs are rapid-charged.

To erase the memory effect it is common practice amongst model car operators to discharge each cell (individually!) via resistor of about 68 Ohm.

This process deliberately "unbalances" the pack.

However, this procedure may result in the charger terminating the process prematurely of the subsequent charge.

**Storage:** Ni-Cd batteries must therefore be discharged down to the final discharge voltage after use, in order to prevent the occurrence of the memory effect, and to maintain the pack's full capacity.

### 5.3 Lead-acid batteries:

Lead-acid batteries cannot be charged using the ecolader. However, in the interests of completeness we are providing a little background information on the subject.

The characteristics of lead-acid batteries are entirely different from those of Ni-Cd sintered-cell packs, which are used as the power source in model aircraft, model cars and hydroplane boats. Lead-acid batteries can only be discharged at relatively low currents if their full capacity is to be exploited, and/or their voltage is not to collapse too far.

As with discharging, these batteries may only be charged at low currents (0.1 C, voltage-limited). The charge period is then in the order of 20 hours.

The nominal capacity (i.e. charge duration) can be reduced very quickly by incorrect maintenance (overcharging, many 100% discharges and especially deep discharges). Read the instructions supplied with your batteries.

**Storage:** if lead-acid batteries are to be maintained at full capacity, they must be stored in the charged state, in contrast to Ni-Cd packs.



## 6 Basic operations:

### 6.1 Button assignment at the standard working level:

After connecting the ecolader to the car battery or a suitable mains power supply the LCD screen shows the standard working level.

**esc, enter, +, -:**  
no function assigned.

**spezial (special):**  
**This** button is used to select the display mode of the two-line LCD screen.  
**See** Section 6.4 for further details.

**menü (menu):**  
**This** button is used to branch off into the menu level of the ecolader, to alter currents, programs and device parameters.  
**Before** branching into the menu level, press one of the three **akku** buttons, so that you see in the first line of the LCD screen the parameters of your selected battery.  
**In** "One-battery-full-screen" mode you can only alter the parameters of the previously selected battery number.

**akku 1, akku 2, akku 3 (battery 1, 2, 3):**  
**If** you give a short press on one of these buttons when in "One-battery-full-screen" mode the display switches over to show data for the battery you have selected.  
**In** "Two-battery-display" mode a brief press on the **akku 2** or **akku 3** button switches the second line of the screen to show battery 2 or battery 3 constantly.

**akku 1, akku 2, akku 3:**  
**If** you hold these buttons pressed in you will see for a period of about 3 seconds an expanded status display on the selected battery, in addition to the switch-over as described above (e.g. **A1 disconnected, A2 charging(1) 1.0A**).  
**In addition** the currently charged-in or discharged charge quantity is shown in line 2 of the screen.  
**Holding** the **akku** button pressed in extends the 3-second period mentioned above.  
**In** the combination programs you can display the charge / discharge quantities of all previously completed phases by pressing the **+** and **-** button within the 3-second period mentioned above. The quantity value of the current phase is not updated during this time. (See also Section 9, monitor displays)

### 6.2 Button assignment at the menu level:

**esc, enter:**  
return to working level.

**+, -:** **Select function:**  
**Leafs through** within a table of functions which are displayed in the second line of the screen.

**Functions** are, for example, a simple display function of device number, selecting the charge or discharge current, selecting a charge or discharge program, and configuring safety functions such as limiting the maximum charge time.

**The** ecolader select offers additional features, including owner's name, date, time of day, and clock-controlled starting time for programs (each battery separately).

**akku 1, akku 2, akku 3, spezial:**  
**Depending** on whether one of the above named functions is battery-specific or charger-specific, you must press one of the **akku** buttons or the **spezial** button to select or alter a function. You then move to the Value (value change) level.  
**Note:** In "One-battery-full-screen" mode only one of the three **akku** buttons is active.

#### User guidance:

**In** the first line of the screen you see the current value; in the second line the associated function.

**In each case** you will see the buttons which are required or assigned at the right-hand edge of the screen, in order to change the value of a function, such as the value of the charge current or the charge termination criterion.:

**?+-** for the **+** and/or **-** button, for leafing through within "select function", e.g. in order to have a quick look at the current settings of the charger.

**?e** for **enter** or **esc** button

**?a** for **akku 1, 2, 3** button

**?s** for **spezial** button



## 6.3 Button assignment at the Value level:

When you have selected a variable battery-specific value, the left-hand side of the first line of the screen shows the battery to which the displayed value refers (e.g.: **A2**).

### **+, -:** Select value:

**Leafs through** in a table of values which are displayed individually in the second line of the screen.

**Values** may be, for example, different charge current values, charge / discharge programs which you can select, but also device parameters (e.g. selecting the max. overall current consumption for the charger). The displayed value which you wish to use must then be selected by pressing the **enter** button.

### **enter:**

**Returns** to the menu level, accepting the value shown in the second line of the screen.

### **esc:**

**Returns** to the menu level without changing the earlier value.

### **spezial:**

**Sets** the just selected value to a default (standard) value (= "enter" function with value already defined). An example is car battery low voltage 11200 mV (11.2 V).

## Complex input functions:

**Multiple** select facilities (e.g. the date) are first selected as a group using the **akku** buttons before the values are entered:

Date using	<b>akku 1</b>	( <b>T</b> = batt 1)
Month using	<b>akku 2</b>	( <b>M</b> = batt 2)
Year using	<b>akku 3</b>	( <b>J</b> = batt 3)
Default value with <b>spezial</b>	( <b>s</b> )	

In this case the second line of the screen helps to guide the user:

**Date: T1, M2, Y3, s**

## 6.4 Special functions:

### Selecting the LCD screen display mode:

(leaf through using **+** **-**, select with **enter**)

**"One-Battery-Screen"** mode: (default)

The 2 lines of the screen display virtually all the adjustment and operational parameters of a *single* battery. In this mode the battery number is enclosed by two black fields (squares) at the start of the second line of the screen.

**"Two-battery-Screen"** mode:

The second line of the screen shows battery 2 or battery 3. In this mode the battery 3 display shows a black field in the first and last thirds of the second line.

**"Temperature display on or off":**

The second line of the LCD screen shows the battery temperature (full-screen mode only, has priority over car battery voltage display).

**"Car battery voltage on or off":**

The second line of the LCD screen shows the power supply voltage (in "Two-battery-display" mode only when battery 3 is displayed). Useful when the ecolader is powered by your car battery. Naturally, the information otherwise shown at this position is no longer visible.

**"Discharge and charge quantity on or off":**

In two-battery-display mode the charge/discharge quantity can be shown instead of battery voltage.

**"Time of day on or off":\***

The ecolader select shows the time of day in the first line of the LCD screen.

**Note:** the information normally shown at this position is overwritten by these displays.

### Switching off the "full" or "empty" beep:

Press any button.

We suggest that you use the **esc** button, to avoid making inadvertent changes to device settings.

### Display of charge/discharge quantity after an error:

Press the corresponding **akku x** button.

## 6.5 Miscellaneous information

**For** charging 6 cells a supply voltage of 12 V is sufficient. The ecolader stays cooler with a 12 V supply than with 13.8 V during the charge process.

**When** charging 7 cells you should use a fully-charged 12 V battery (or 13.8 V mains PSU).

**If** the ecolader is required to operate for long periods at high charge / discharge currents, we recommend that you connect a fan to the cooling fan socket on the left-hand side of the charger, in order to cool the heat-sink on the rear of the case. This will avoid the safety circuit tripping, which reduces current and/or switches the ecolader off if its temperature reaches about 100°C.



## 7 Connecting the charger, setting the default values

Please read Section 1 "Warnings" and Section 2 "How to obtain reliable, trouble-free operation". There you will find valuable information which you should know before you attempt to connect and use the charger.

### 7.1 Before connecting the unit

Take the **ecolader** out of its box before using it, to ensure an adequate flow of cooling air when it is running.

Do not connect the charger to the battery or batteries you wish to charge.

Ensure that the power supply (12 V car battery, 12-13.8 V mains PSU) is providing stable power without any unwanted effects.

Ensure that the power supply is making really sound contact with the terminals of the **ecolader**. This is not possible with cheap banana plugs and car cigar lighter plugs, and these should therefore not be used.

### 7.2 Switch on the power supply

If you are using the car battery in your vehicle: - switch off the engine.

If you are using a suitable mains PSU: - switch on the PSU beforehand.

### 7.3 Connect the **ecolader** to the power supply

The power terminal clips should be clamped onto the contact surfaces of the power supply maintaining correct polarity, working quickly and confidently.

The integral fan will run briefly, then stop.

After connection the screen will show the following Ready messages:

```
eco-select V1.xx (or ecolader+)
(c)schulze gmbh
```

```
Date DayOfWk Time (not with ecolader+)
schulzelektronik (or your name)
```

```
A1 ready Auto C
■A1■L^_____q0000 ("One-Batt-Screen")
```

If none of these messages appears, and you just see black squares, immediately disconnect the unit; damage may ensue if the charger is left in an undefined state. Wait 5 seconds, repeat step 7.3.

If nothing at all appears on the screen, you have probably connected + to -.

### 7.4 Typical first charge process

#### 7.4.1 Default values (General Reset)

If you don't know the configuration of the ecolader we recommend that you start by resetting the unit to the default values.

This Reset sets the parameters for each battery output separately to values which are usable for almost all charging applications.

At the same time the device parameters can be set to standard (default) values.

Default value list: see Section 8.xx.

Procedure:

Press the **menü** button.

The screen displays the following:

```
A1:Auto C (or other program)
C/D-Program ?a
```

Press the - (minus) button 6 x to reach the default value function.

The screen now shows the following:

```
- - - - -
DefaultValues?as
```

Press the **akku 1** button to set the default values for battery 1.

The screen displays the following:

```
DefaultValues?A1
<esc> <enter>
```

Confirm with the **enter** button.

The screen briefly shows the message:

```
DefaultValues?A1
executed
```

and then switches back to:

```
- - - - -
DefaultValues?as
```

Press the **spezial** button to set the default values for the general operational parameters of the ecolader.

The screen displays the following:

```
DefaultValuesECO
<esc> <enter>
```

Confirm with the **enter** button.

The screen briefly shows the following:

```
DefaultValuesECO
executed
```

and then switches back to:

```
- - - - -
DefaultValues?as
```

Press the **esc** button to revert to the standard display.

The screen now shows the following:



**A1 ready auto C**  
**■A1■L^\_\_\_\_\_q0000**

The first line of the screen shows that charge output 1 (A1) is ready, and that the fully automatic charge program **Auto C** will be used.

The second line features "A1" enclosed by two black fields (blocks), indicating that the "One-battery-full-screen" mode has been selected, and that the data on the screen applies to battery 1.

The slightly smaller L after A1 shows that the linear charge process has been set.

The "pitched roof" (circumflex) symbol shows that peak-detect charge termination has been selected.

The underlines are place-holders for the temperature, termination delay time or start time activation.

The q stands before the 4-digit charge quantity display.

The screen does not display the maximum charge current which the automatic calculation circuit could set.

#### 7.4.2 Displaying / altering the max. charge current for Battery 1:

For a practice run, press the **akku 1** button briefly, in order to switch the screen to "Display Battery 1" mode. (If, for example, you had previously pressed the **akku 3** button, all the subsequent monitoring information would refer to battery 3).

Now press the **menü** button once.

(This takes you to Select Function for the charge / discharge program)

Press the **+** button once.

(This takes you to maximum charge current within Select Function)

**A1 : I=6 . 0A**

**ChargeCur (max) ? a**

With the current value displayed in the first line, for example, the **fixed C** program could later charge a good 2 Ah pack without any problem.

Pressing one of the **akku 2** or **akku 3** buttons in the selected "One-battery-full-screen" mode would be ignored (try it out), but in "Two-battery-display" mode this would switch to Select Value for the maximum charge current of Battery 2 to Battery 3.

Now press the **akku 1** button once.

This takes you to Select Value for the maximum charge current for battery 1.

The screen swaps the lines appropriately.

**ChargeCur (max) A1** (previously line 2)

**I=6 . 0A +-se** (previously line 1)

I.e. the values which can be altered using the + and - buttons are always displayed in the second line of the screen.

Pressing the + or - buttons at this point would now alter the current value, and pressing the **enter** button would select the new value.

Please press the **esc** button **twice** at this point to return to the standard working level, as we do not want to change the charge current value at this juncture.

#### 7.4.3 Starting a charge program

Now the battery can be connected, taking care to maintain correct polarity.

A short double-beep signals the start of an automatic program.

The ecolader initially charges the battery at 300 mA for about 15 seconds, in order to gain the information it needs to calculate the initial charge current.

The first line of the screen shows the charge time, the charge voltage and the current charge current. When requested (by pressing the **akku 1** button) the screen can show the current charged-in quantity. Note that the charge quantity can be displayed constantly if you press the **spezial** button.

The charge current is then raised gradually over the first few minutes of the charge until it reaches the set maximum value, provided that the state of the battery and the number of cells in the pack allows this. Batteries of low capacity or high internal resistance will not reach maximum charge rate.

If your 1700 or 2000 cells do not reach the 6 A value, then your battery has either been poorly maintained, or has already "had it".

The speed and extent to which the ecolader applies charge current to your batteries, using the automatic charge process (patent applied for), is a direct indicator of the state of your batteries (low internal resistance = high charge current); although it may also indicate (just as accurately) that your charge cables are not up to the job (long or thin cables = high resistance = low charge current)!

The automatic current calculation allows you to see the state of your battery immediately.

#### 7.4.3 "Full" display:

Once a reset has been carried out (as described above), the battery's "full" condition is detected by the voltage peak method.

The ecolader features a special form of "full" detection based on fuzzy logic, which makes it largely proof against interference. Professionals may wish to adjust some parameters of the peak termination system, but normally it is best to leave it at the default setting.

The first line of the screen shows the charge time, an inverted f (= full) alternating with a t (= trickle charge), the final charge voltage and the reason for termination (PEAK), alternating with the charged-in quantity.

The buzzer sounds briefly.



## 8 Altering the characteristics of the charger

**Tabular summary** in the order of the table stored in the ecolader:

To leaf through in the Function Table press the **menü** button once after the Ready message appears, with the ecolader connected to the power supply. This takes you to Select Function (8.15), printed below in bold type:

[*] ecolader select only	Page
8.1* Calibrating the 12-bit A/D-converter.	10
8.2* Owner's name . . . . .	11
8.3* Date . . . . .	11
8.4 Time of day . . . . .	12
8.5 Start time . . . . .	12
8.6 Max. charge time . . . . .	13
8.7 Max. charge quantity . . . . .	13
8.8 Termination temperature . . . . .	14
8.9 Termination delay . . . . .	14
8.10 Termination check count . . . . .	15
8.11 Termination sensitivity . . . . .	15
8.12 Termination criterion . . . . .	16
8.13 Charge method . . . . .	17
8.14 Charge current . . . . .	18
<b>8.15 Select charge/discharge program</b>	<b>18</b>
8.15.1* Sel.CD . . . . .	18
8.15.2 Auto C . . . . .	19
8.15.3 Fix C . . . . .	19
8.15.4 Fix -D . . . . .	20
8.15.5 Auto-D . . . . .	20
8.15.6 Combi programs ...DC . . . . .	21
8.15.7 Combi programs ...CD . . . . .	21
8.16 Discharge current . . . . .	22
8.17 Min. discharge voltage . . . . .	22
8.18 Cell count correction . . . . .	23
8.19 No. of cycles of combi program . . . . .	23
8.20 Program after Power-On Reset . . . . .	24
8.21 Default values for batteries and charger . . . . .	24
8.22 Max. primary current . . . . .	25
8.23 Car battery - min. voltage threshold . . . . .	26
8.24 Light / buzzer function at battery full . . . . .	26
8.25 Display device No. . . . .	27

### 8.1\* Calibrating 12-bit ADC

#### Description:

**The** ecolader-select features a precision 8-channel 12-bit analogue/digital converter which is used to measure the battery cells. **To** ensure that all 8 measurement channels work exactly "in step", the charger also features a calibration facility in the prototypes. The facility was incorporated to compensate for tolerances in the prototypes, which were fitted with input voltage divider resistors of 5% tolerance.

**However**, since production versions are equipped with 0.1% (!!!) resistors, the maximum error without calibration is well below 1% (typical 3 mV) in any case, which means that this menu point is to be considered of checking the 8 channels of the A/D converter.

#### Preparation:

**Connect** the 10-pin plug on the eco-elast-0.40 Ohm discharge load resistor (accessory) to the measurement input on the right-hand side of the charger. Note that this is an exceptional procedure. This sets all the measurement inputs to the same potential and connects them to a calibration voltage source. On no account connect the red banana plug of the discharge load resistor!

#### Branch to the calibration menu:

Press the **spezial** button, then:

#### Carry out the 8 AD-channel voltages:

Press the **enter** button, or

#### Interrupt:

Press the **esc** button

#### Return to the Select Function menu:

**Both** actions (above) takes you back automatically to the Select Function menu.

**Disconnect** the 10-pin connector.

#### Display:

**After** a short waiting period the ecolader confirms that output to the PC is complete by emitting a short beep.

**If** you are using the **winsoft** software on your PC, you can observe the data output in the **Info online** window.



## 8.2\* Owner's name

### Description:

The ecolader-select allows you to enter your name or telephone number in the 16-character screen area, so that you can easily identify your own charger.

### Activating the menu point:

Press the **spezial** button.

The first line of the screen then displays the key to the buttons, while the second line shows the name for you to change.

You will see a cursor (small horizontal line) above the letter which can be changed, i.e. the cursor appears between the two lines of the display.

### Entering your name:

The cursor is initially located above the first letter of the name.

Press the **+** or **-** button until the screen shows the letter (or other character) which you want at that position.

Release the button.

Press the **akku 3** button to confirm the new letter and move to the next letter on the right.

If you make a mistake, press the **akku 2** button to move back one space.

Press the **akku 1** button between the first name and the last name to produce a space. The same applies at the end of the name if you want to erase the last few letters of the old name.

The **spezial** button resets the name to **schulzelektronik**.

### Display:

The screen shows a new letter or symbol, or a movement of the cursor, immediately after you press the appropriate button.

### Return to the Function Menu:

Press **enter** to store the new name, or press **esc** to revert to the old name and discard your changes.

## 8.3\* Date

### Description:

The ecolader-select allows you to enter the current date, as it includes a special "time-keeper" module which maintains the date information even when the charger is switched off, and updates it daily. The date information is not required internally, unlike the time information (see Sections 8.4).

### Activating the menu point:

Press the **spezial** button.

This action shows the current date in the first line of the screen; the second line provides a brief key to the method of changing it:

Day	<b>akku 1</b> button
Month	<b>akku 2</b> button
Year	<b>akku 3</b> button
<b>15.06.98</b>	<b>spezial</b> button (default value)

After you have pressed one of the buttons stated above you move on to

### Select value:

Press the **+** or **-** button.

The value to be changed appears in the second line of the screen.

### Confirm value:

Press **enter**

### Interrupt:

Press **esc**

### Note:

The default value is roughly in the middle of the overall range, and serves as a good starting point when you need to set a completely new date.



## 8.4 Time of day, day of week\*

### Description:

The ecolader-select allows you to enter the current time of day, as it contains a special "timerkeeper" module which maintains the time information even when it is switched off, and updates the information every minute. The "day of the week" information is not required internally, unlike the "time of day" information which is part of the facility to start a program automatically at a particular time of day (see also Section 8.5).

The ecolader + does not feature the "time-keeper" module, and you have to enter the time of day every time you connect it to the power source.

### Activating the menu point:

Press the **spezial** button.

When you have done this the first line of the screen displays the current day of the week\* followed by the time of day. The second line shows a brief key to the buttons used to change the information:

**Day of week\*** **menü** button  
**Hours (H1)** **akku 1** button  
**Tens/min.(TM2)** **akku 2** button  
**Minutes (M3)** **akku 3** button  
**Mi 12:30** **spezial** button (default value)

Once you have pressed one of the buttons stated above you move to

### Select value:

Press the + or - button.  
 The value to be changed appears in the second line of the screen.

### Confirm value:

Press **enter**

### Interrupt:

Press **esc**

### Note:

The default value is roughly in the middle of the overall range, and serves as a good starting point when you need to set a completely new time of week.

It is not recommendable to change the unit's internal clock if a start time is activated or the Sel.LE program is used. This eliminates the danger of mistakes or unwanted starts.

## 8.5 Start time

### Description:

The ecolader includes the facility to enter the time of day at which the selected program is to start.

### Activating the menu point:

Press the **akku x** button.

When you have done this the first line of the screen displays the current day of the week followed by the time of day. The second line shows a brief key to the buttons used to change the information:

**Current time (T)** **menü** button  
**Hours (hh1)** **akku 1** button  
**Tens / min.(tm)** **akku 2** button  
**Minutes (mm3)** **akku 3** button  
**off** **spezial** button (or after POR)

Once you have pressed one of the buttons stated above you move to

### Select value:

Press the + or - button.  
 The value to be changed appears in the second line of the screen.

### Confirm value:

Press **enter**

### Interrupt:

Press **esc**

### Notes:

When you connect the charger to the car battery (Power On Reset) the start time is switched off.

The start time can be set to any time in the following 24-hour period. Note: if you set a start time which is "lower" than the unit's internal clock time, the program will therefore not start immediately.

The **menü** button copies the current time of day. This can also be used as the starting point for setting the start time.

All 3 battery outputs can be started and operated automatically using completely different programs and at different times.

### Display:

Near the Ready message (or in the second display line of the "one battery full screen") you will see a clock symbol if a start time has already been selected and set.

If the battery has already been connected and is ready for use, but the start time has not yet been reached, the screen displays the following message:

**WaitUntil>hh:mm** (hh:mm is the start time)



## 8.6 Maximum charge time

### Description:

**This** is a safety function.

**If** for any reason the charge termination criterion you have selected should fail, the charge current is switched off after the set maximum charge time has elapsed.

### Activating the menu point:

Press the **akku x** button.

### Select value :

Press the **+** or **-** button.

### Value range:

5 min ... 50 min ... >11 h (i.e. > 660 min).

### Confirm value:

Press **enter**

### Interrupt:

Press **esc**

### Special feature:

**You** will see a **>** symbol in front of the largest number in the table. This means that the charge time monitor is switched off!

### Notes:

**The** charge time limiter and the option of switching off the charge time limit described in this Section do not disable the automatic charge termination circuits.

**If** you wish to disable the automatic charge termination system, please use the continuous charge program (see Section 8.12).

**It** is particularly important to set charge time limiting and charge quantity limiting to values appropriate to the battery when you are charging transmitter batteries.

**If** this safety function trips, it ends any combination program (...CD or ...DC) which may be in use at that time.

## 8.7 Max. charge quantity

### Description:

**This** is a safety function.

**If** for any reason the charge termination criterion you have selected should fail, the charge current is switched off after the set maximum charge quantity has been supplied.

### Activating the menu point:

Press the **akku x** button.

### Select value:

Press the **+** or **-** button

### Value range:

100 mAh ... 3000 mAh ... >11 Ah

### Confirm value:

Press **enter**

### Interrupt:

Press **esc**

### Special feature:

**You** will see a **>** symbol in front of the largest number in the table. This means that the max. charge quantity monitor is switched off!

### Notes:

**It** is particularly important to set charge time limiting and charge quantity limiting to values appropriate to the battery when you are charging transmitter batteries.

**The** default value (3000 mAh) is correct for selected 2000 mAh packs which have been discharged down to 0 V. For normal 1700 cells which have only been discharged down to 0.7 V per cell, a limit value of 2400 - 2600 mAh is a safer option.

**If** this safety function trips, it ends any combination program (...CD or ...DC) which may be in use at that time.



## 8.8 Termination temperature

### Description:

This function has a dual purpose: it provides extra safety when the charge is terminated using the (voltage) peak detection feature.

It can also be used as an independent method of "battery full" charge termination.

### Activating the menu point:

Press the **akku x** button.

### Select value:

Press the **+** or **-** button.

### Value range:

23° C ... 45° C ... 50° C.

### Fixed temperature values:

41° C, 65° C (see notes below).

### Confirm value:

Press **enter**

### Interrupt:

Press **esc**

### Notes:

The temperature limit values can be set separately for each battery, but the charger only has one temperature sensor, which must be activated on a battery-specific basis under the menu point **Charge Termination Criterion** (see Section 8.12).

In addition a fixed, non battery-specific temperature value of 65° C is active for the whole device during every charge and discharge process as an "emergency power cut-off" system. Simply push the temperature sensor into the battery to be monitored. Moreover there is a non-selectable temperature limit of 41° C which delays a discharge process involving a battery above this temperature until it cools down to below this value; this only applies if temperature termination has been selected.

The temperature sensor should be plugged into the socket marked **cal** on the ecolader +.

## 8.9 Termination delay

### Description:

This function is useful with cells which really refuse to be charged by erroneously tripping the peak detection system. It does this by charging for the first few minutes without checking the voltage peak.

### Activating the menu point:

Press the **akku x** button.

### Select value:

Press the **+** or **-** button.

### Value range:

1 min ... 8 min ... 10 min.

### Confirm value:

Press **enter**

### Interrupt:

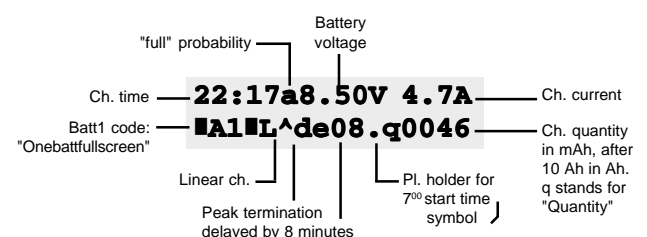
Press **esc**

### Notes:

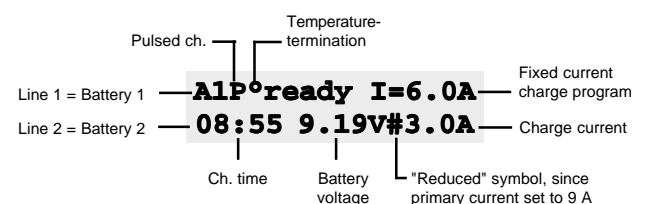
However, since the automatic charge termination system is very reliable in operation, and since a wide variety of termination criteria are taken into account and analysed, this function only needs to be activated in very rare cases.

Entering a delay time does not immediately result in a delayed activation of the automatic charge termination system. This has to include the additional "del." component in the termination criterion (see Section 8.12).

### "One-Batt-Screen" mode



### "Two-Batt-Screen" mode



Indirect displays: Batt. 2 set to peak term., as battery 1 is set to temp. termination. Batt. 2 is on pulsed charge, as battery 1 is set to pulsed charge.



## 8.10 Termination check count

### Description:

This function is used to configure the automatic charge termination system.

Checks on the probability of the battery being fully charged are made at 30-second intervals after the first peak is detected.

The battery is only considered to be full when the test result is positive over the desired number of checks, and the charge current is then switched off. This means that brief variations in battery voltage due to cell "noise" or other effects do not result in premature charge termination.

**Note** that too many checks prolong the test period and allow the battery to heat up more than is necessary.

### Activating the menu point:

Press the **akku x** button

### Select value:

Press the **+** or **-** button

### Value range:

2 x ... 3 x ... 7 x (at approx. 30 s intervals)

### Confirm value:

Press **enter**

### Interrupt:

Press **esc**

### Caution:

**Do not** change this parameter unless you understand exactly how the system works!

### Notes:

The number of termination checks works hand in hand with charge termination sensitivity and the fixed check time interval.

**Three** checks with a sensitivity of 3 mV / cell, using a 6-cell pack and a test period of about 90 seconds, produce a **minimum** voltage drop of:

**3 mV \* 6 cells \* 3 checks = 54 mV**

The actual voltage drop is usually higher (100-400mV).

If the batteries are too hot after the charge termination, you should reduce the number of checks to 2 (e.g. if you are charging at more than 6 A). If they are too cold, the number of checks can be increased to 7.

**When** pulsed charging is in use, the charge is terminated after 5 checks at most.

## 8.11 Termination sensitivity

### Description:

This function is used to configure the automatic charge termination system.

The likelihood that a battery is fully charged varies according to the magnitude of the voltage drop after the peak. This voltage drop must be greater than the set sensitivity over the time period of about 30 seconds (fixed internal period) if the battery is to be recognised as fully charged.

### Caution:

This parameter prevents erroneous premature terminations. It is not designed to charge a battery "fuller than full" by setting high values. Please see also Section 8.10.

High values reduce the possibility of erroneous terminations, but may not be achieved by the battery under certain circumstances due to low charge currents (owing to the automatic current calculation system towards the end of the charge) with the possible result that the battery could be overcharged.

The sensitivity value you enter refers to a single cell, i.e. a 6-cell pack will exhibit six times the value. This value is calculated by the automatic charge termination circuitry based on the calculated number of cells.

### Activating the menu point:

Press the **akku x** button.

### Select value:

Press the **+** or **-** button.

### Value range:

**batt. 1, 2:** 0 mV ... 3 mV ... 5 mV (per cell).

**batt. 3:** 0 mV ... 1 mV ... 5 mV (per cell).

### Confirm value:

Press **enter**

### Interrupt:

Press **esc**

### Notes:

**Hybrid cell batteries** (Panasonic, yellow Sanyo) should be charged with the sensitivity reduced to 1 mV.

**Nickel Metal Hydride batteries** should be charged with the sensitivity reduced to 0 (zero), and a fixed current setting of about 0.5 to 1 C.



## 8.12 Termination criteria

### Description:

This function is used to define which criterion the ecolader is to use to detect the "battery full" condition

The following criteria are available for you to select:

### Peak:

**Termination criterion** is the voltage drop in the charge voltage which occurs with full cells due to temperature rise.

**Peak** termination is also sometimes termed Delta-Peak termination.

### Peak and temperature:

**Termination criterion** is the voltage drop in the charge voltage combined with cell temperature. This system only works if the temperature sensor is connected and a sensible termination temperature has been set (see Section 8.8).

**That** criterion which first registers "battery full" effects the termination of the charge current.

### Continuous charge (no termination)

For safety reasons the charge current is pre-set to 300 mA when you select continuous charging, although it is possible to increase it to a maximum of 500 mA.

### Temperature termination:

**This termination criterion** is increased cell temperature.

The function only works correctly if the temperature sensor is connected, and a sensible termination temperature has been set; the optimum temperature varies with the different methods of charging (see Sections 8.8 and 8.13).

### Peak plus delay:

**Peak** detection is only activated after the time set in Section 8.9 has elapsed.

### Peak plus delay and temperature:

**Peak** detection is only activated after the time set in Section 8.9 has elapsed. The temperature monitoring is active from the start of the charge process.

### Activating the menu point:

Press the **akku x** button.

### Select:

Press the **+** or **-** button.

### Select range:

As previously described.

### Confirm selection:

Press **enter**

### Interrupt:

Press **esc**

### Caution:

**Since** the ecolader only has one temperature sensor socket, you should make certain that you have assigned the sensor to the correct battery: it makes no sense to activate temperature termination for Battery 1 and Battery 2 if both packs are to be charged simultaneously, as it is not possible to attach one sensor to both batteries at the same time.

**For** this reason all other batteries are switched to peak detect termination if temperature termination is selected for one pack.

**Naturally**, you can expect fatal results if the temperature sensor is connected to Battery 1, but temperature termination is activated for Battery 2.

### Special feature:

**Even** when you activate pure temperature termination, the peak-detect system still works in the background.

**Should** you happen to forget to attach the temperature sensor to the battery, the peak detect system will activate the buzzer to remind you of your error.

**When you carry out a Power-On-Reset, peak termination is always (additionally) activated for reasons of safety (i.e. sensor may not be attached to battery), and a continuous charge or a delay period will be switched off.**

### Display:

A "°" indicates that temperature termination is activated, and a "▲" indicates peak detection.

The criterion which has resulted in switching off the charge current is displayed on the far right of the screen after the charge:

**PEAK** and **TEMP** refer here to the charge termination criteria.

If after the charge you see **QUANT** or **TIME**, the charge process was interrupted prematurely because one of the safety limits was exceeded.



## 8.13 Charge method

### Description:

**With** this function you determine the method of charging to be used to charge your packs.

**The** following methods are available:

### Linear charging:

**The** most commonly used and straightforward of all methods of charging.

**The** charge current stays constant for minutes at a time, and is only interrupted briefly for the automatic termination system to take measurements.

**If** you charge a pack using automatic current calculation, you may find that a different charge current is applied after one of the short measurement pauses, but it will then be held constant again for a long period.

### Pulse charging:

**Pulse charging** means that the charge current is divided up into pulses of current. After each pulse of charge current there follows a "rest" period in which no current flows.

To avoid placing too severe a load on the mains PSU or car battery due to superimposed pulses, the charge pulses for Battery 1 and Battery 2 are applied alternately.

**For** this reason the pulsed current for Battery 1 is 1.5 times the average charge current (soft pulses), and the pulsed current for Battery 2 is 3 times the average current (hard pulses).

**It** is essential that your power supply can deliver these increased peak currents; this applies in particular to mains PSUs.

**For** this reason, pulsed charging applies to Battery 1 and Battery 2 simultaneously.

**Example:** Batt 1: 6 A --> 9 A pulsed current, Batt 2: 5 A --> 15 A pulsed current!

### Linear charging with refresh pulses:

The charge process is interrupted at particular intervals by discharge pulses at the same rate as the charge current.

### Pulse charging with refresh pulses:

The charge is interrupted at particular intervals by discharge pulses at the same rate as the pulsed charge current.

**Refresh pulses** can be set separately for Battery 1 and Battery 2.

### Activating the menu point:

Press the **akku x** button.

### Select:

Press the **+** or **-** button.

### Select range:

**As** described on the left.

### Confirm selection:

Press **enter**

### Interrupt:

Press **esc**

### Notes on refresh charging:

**The** discharge pulses are intended to accelerate the regenerative effect of old batteries, and reduce the memory effect.

**An** additional advantage is that the temperature **rise** sets in later as the packs approach the fully charged state. Batteries therefore stay cooler towards the end of the charge.

**During** refresh charging you will hear quiet crackling noises from the battery; this is perfectly normal and is due to the high-current discharge pulses.

### Important note regarding refresh charging:

**It** is important to take into account the delayed temperature rise in a battery by adjusting the temperature setting to lower values if you are using temperature charge termination.

### Display:

**The** screen displays various symbols to indicate the charge method you have selected:

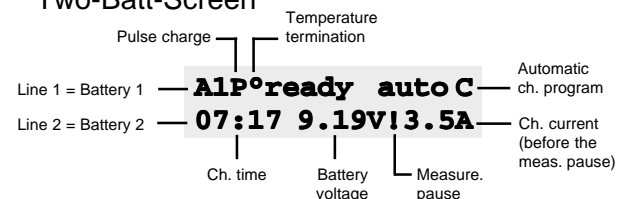
"L" for **Linear** charging

"P" for **Pulse** charging

"f" for **Refresh** charging

**The** symbols on the screen are slightly smaller than the usual symbol height, in order to be able to display the combination "Lf" and "Pf" in a single display field.

### "Two-Batt-Screen"



Indirect displays: Batt. 2 set to peak termination, as Batt. 1 is set to temp. termin. Batt. 2 set to pulse charging, as Batt. 1 is being pulse-charged.



## 8.14 Charge current

### Description:

This function is used to select the maximum possible charge current which the ecolader is to apply when charging.

### Activating the menu point:

Press the **akku x** button.

### Select value:

Press the **+** or **-** button.

### Value range:

**Battery 1:** 300 mA ... 6 A ... 10 A.

**Battery 2:** 150 mA ... 4 A ... 5 A.

**Battery 3:** 100 mA ... 1 A ... 2 A.

### Confirm value:

Press **enter**

### Interrupt:

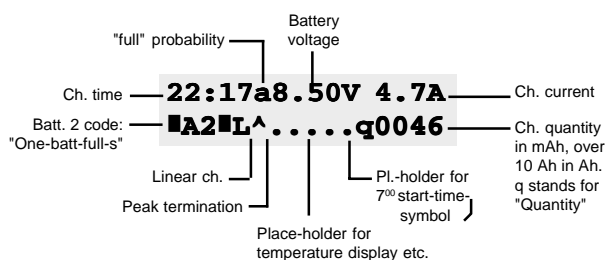
Press **esc**

### Notes:

The actual charge current may be lower than the value you have set, depending on the number of cells, the maximum total current drain (primary current) and - in particular - if automatic current calculation is in use.

**Altering** the charge current during a charge process only becomes effective if the change cannot upset automatic (peak) termination. That means: if the screen is displaying a "full" probability symbol (a, b...; see below), the charge continues temporarily with an unchanged current.

### "One-batt-full-scrn" mode



## 8.15 Charge/disch. program

This function is used to determine the charge or discharge program which is to be used.

### Activating the menu point:

Press the **akku x** button.

### Select:

Press the **+** or **-** button.

### Select range:

As described below.

### Confirm select:

Press **enter**

### Interrupt:

Press **esc**

### 8.15.1 Sel.CD\*

#### Purpose:

This program is designed for measuring packs of cells using a high discharge current.

#### Sequence:

**Before** the discharge process the battery is fully charged using the auto C program.

**After** the "full" termination the unit waits about 5 minutes and then re-starts the auto C program.

**After** the "full" termination the unit waits a further 5 minutes and then starts the auto C program a third time.

The point of this procedure is to have all packs "brim-full", even if individual cell capacities are not identical.

**After** the charge process the pack is discharged at high rate using the fix--D program.

#### Note:

**For** discharge currents above 10 A the external discharge load resistance must be connected.

The standard settings for charge and discharge current and limiting still apply.

#### Display:

In the "wait" pauses the following message appears on the screen:

**WaitUntil>hh:mm**; hh:mm = time of day.



## 8.15.2 Auto C

### Purpose:

**Optimum** program for charging batteries quickly and completely, with very few pre-conditions (see select criteria below).

### Description:

**The** ecolader automatically calculates the ideal charge current to suit the battery.

**This** it does by measuring the pack continuously, and repeatedly adjusting the charge current to suit the pack's energy absorption capacity and/or the maximum capacity of the ecolader.

**Initially** the unit charges at 300 mA for a brief period, then it raises the current; towards the end of the charge the current is reduced again.

**The** program charges until it detects the "full" state, then switches to a trickle charge.

**The** calculated charge current is reduced if the charger threatens to overheat or overload.

### Select criteria:

**As** a rule the fully automatic "Auto C" charge program is the best choice for Ni-Cd packs.

**It** is not necessary to have an accurate knowledge of the type of Ni-Cd sintered cell battery provided that the capacity is within the range 300 mAh to 5 Ah - **the only pre-conditions are adequate cross-section of the charge cable (2.5 mm<sup>2</sup>), high-quality connectors and a pack consisting of soldered cells.**

**If** the calculated charge currents turn out too low due to poor battery condition, the time limit trips to restrict the length of the charge.

**For** this reason it may make sense initially to use a fixed current program (eg. Fix2CD) with a charge rate of 0.5 C ... 1 C, until the pack has to some extent come "back to life".

**If** the battery will not accept currents above 1 C ... 2 C in automatic mode, then either it is not suitable for rapid-charging, or it has come to the end of its life - it's "had it".

## 8.15.3 Fix C

### Purpose

**If** you know the permissible charge currents for your batteries, you can use a suitable charge program with a fixed, defined current.

**This** allows you to carry out balancing charges, standard and rapid charges (low, moderate and high currents respectively) with the charge times you calculate - depending on the batteries' initial state of charge.

### Description

**The** selected program immediately starts charging using the current you have selected. The charge current is maintained until the pack is recognised to be fully charged.

**The** charge rate is only reduced if the selected current and the pack's rising voltage present a danger of the unit overheating or overloading.

### Select criterion:

**Especially** with Ni-MH batteries manual current selection (0.5 C to max. 1 C) is always preferable, with the automatic charge termination set to "sensitive" (see Section 8.11).

**With** a small number of cells and a high charge current you can make the task of the automatic termination circuit easier by selecting a fixed current program:

With 8 Ni-Cd cells the charge current should be at least 1.5 C, with 6 cells 2 C and with 4 cells more than 3 C, so that a detectable voltage peak can occur. Read the manufacturer's notes to check that the pack is approved for charging at these currents!

**A** fixed current program is the only alternative if you are obliged to charge batteries using charge leads which are too thin, because in that case the automatic current calculation circuit cannot work correctly. The high resistance of the small cable cross-section would be interpreted as internal battery resistance, and this would cause the charge current to be lower than ideal.

**The** same applies if the calculated charge currents in automatic mode turn out too low due to poor battery condition; in this case the time limiter will trip. In such cases balance the battery beforehand using a fixed current program.

**A** fixed current program is also a good alternative when you wish to charge a pack of known capacity within a particular timespan.



### 8.15.4 Fix -D

**Purpose:**

**Program** designed to discharge a pack quickly to the pre-set final discharge voltage.

**Description:**

**The** ecolader checks whether the set maximum discharge current will exceed the permissible discharge power limit.

**If** so, it reduces the discharge current to a permissible value, and superimposes a flashing asterisk on the LCD screen.

**If** not, the ecolader discharges the pack using your chosen current.

**The** program discharges down to the final discharge voltage at a constant current.

**After** this the discharge process is halted.

**Notes:**

**Please** bear in mind that high discharge currents (around 2 C or higher) will cause the battery to heat up. Cool it if necessary.

**You** can allow the ecolader to calculate the final discharge voltage automatically, or set a limit value instead (see Section 8.17).

**At** high discharge currents, and - in particular - when packs are being discharged simultaneously at akku 1 and akku 2 outputs, the charger can get very hot. To avoid over-heating, the discharge current is reduced in two stages, at which time the "reduced" symbol ("\*") appears on the screen. Even when cooled down the full current will not flow until at least one pack is completely discharged.

### 8.15.5 Auto-D

**Purpose:**

**Optimum** program for rapidly but gently discharging batteries completely down to the final discharge limit. Ideal for erasing the memory effect of Ni-Cd batteries, and/or preparatory to completely discharging them using individual resistances.

**Description:**

**The** ecolader checks whether the set maximum discharge current will exceed the permissible discharge power limit.

**If** so, it reduces the discharge current to a permissible value, and superimposes a flashing asterisk ("\*") on the LCD screen.

**If** not, the ecolader discharges the pack using your chosen current.

**The** program discharges down to the final discharge voltage at a constant current.

**After** this the discharge current is reduced gradually so that the the voltage does not fall below the set final discharge voltage limit.

**When** the discharge current falls to a fraction of the pre-set value, the discharge process is halted.

**Notes:**

**Please** bear in mind that high discharge currents (around 2 C or higher) will cause the battery to heat up. Cool it if necessary.

**You** can allow the ecolader to calculate the final discharge voltage automatically, or set a limit value instead (see Section 8.17).

**At** high discharge currents, and - in particular - when packs are being discharged simultaneously at akku 1 and akku 2 outputs, the charger can get very hot. To avoid over-heating, the discharge current is reduced in two stages, at which time the "reduced" symbol ("\*") appears on the screen. Even when cooled down the full current will not flow until at least one pack is completely discharged.



### 8.15.6 Aut\_DC, Fix\_DC (\_ = 1...8 and X)

#### Purpose

The battery care programs (1DC ... XDC) balance your batteries in order to erase any existing memory effect, or to force the chemistry to "get going". Those batteries in particular which are only slightly discharged (e.g. transmitter and receiver batteries), need to be discharged completely and then recharged on a regular basis. Irregularly maintained or brand-new packs often require this procedure to be repeated several times in sequence.

#### Description

**The** battery connected to the charger is discharged to the final discharge voltage using the **xxxx-D** program, and then recharged using the **xxxx C** program (repeated n times if you are using the **xxx\_DC** program). The program continues charging until the peak is detected, then switches to a trickle charge.

**The** initial value for the discharge current is calculated from the maximum discharge power and/or the maximum permissible discharge current for the ecolader.

**When** the final discharge voltage is reached using one of the automatic programs, the discharge current is reduced until it reaches a low value.

**Continuous** charge current adjustment relative to the pack's energy absorption capacity in the automatic programs.

**The** calculated charge current is reduced if there is a danger that the unit will overheat or be overloaded.

#### Select criteria:

**If** the calculated charge currents turn out too low in automatic mode due to poor battery condition, the time limiter eventually trips.

**For** this reason it may make sense to start by using a fixed current program (e.g. Fix2DC) and a current of 0.5 C ... 1 C until the battery has to some extent "come back to life".

**If** the battery refuses to accept currents above 1 C ... 2 C in automatic mode, it is either unsuitable for rapid-charging, or it is approaching the end of its life; it's "had it".

### 8.15.7 Aut\_CD, Fix\_CD (\_ = 1...8 and X)

#### Purpose

This program is ideal for studying the changing behaviour of individual battery packs. It provides a useful means of checking their usefulness based on varying capacity data.

#### Description

**The** battery connected to the charger is charged up using the **xxxx C** program, and then discharged again using the **xxxx-D** program.

**In** the automatic programs the ecolader automatically and regularly calculates the optimum charge current for the battery.

**The** calculated charge current is reduced if there is a danger that the unit will overheat or be overloaded. The program continues charging until the peak is detected.

**After** this, the battery connected to the unit is discharged to the final discharge voltage.

**The** initial value for the discharge current is calculated from the maximum discharge power and/or the maximum permissible discharge current for the ecolader.

**When** the final discharge voltage is reached using one of the automatic programs, the discharge current is reduced until it reaches a low value.

#### Select criteria:

**If** the calculated charge currents turn out too low in automatic mode due to poor battery condition, the time limiter eventually trips.

**For** this reason it may make sense to start by using a fixed current program (e.g. Fix2DC) and a current of 0.5 C ... 1 C until the battery has to some extent "come back to life".

**If** the battery refuses to accept currents above 1 C ... 2 C in automatic mode, it is either unsuitable for rapid-charging, or it is approaching the end of its life; it's "had it".

#### Important with all combination programs:

**These programs only function if you are using peak-detect or temperature termination. Exceeding a charge quantity or charge time causes the combination program to be halted.**

**Setting** the number of cycles: see Section 8.19



## 8.16 Discharge current

### Description:

This function is used to select the maximum possible discharge current which the ecolader is to use for discharging.

Any current value above 10 A can be achieved using a separate discharge load resistance (accessory) plugged into the charger.

The discharge load resistance is rated at 0.40 Ohm, and is ideal for a standard 20 A discharge with a 6-cell pack. The resistance provides the basic load at the start of the discharge process, and the internal discharge current sink maintains a constant software-controlled 20 A discharge rate as battery voltage falls off.

### Activating the menu point:

Press the **akku x** button.

### Select value:

Press the **+** or **-** button.

### Value range:

**Battery 1:** 300 mA ... 6 A ... 10 A ... 32 A.

**Battery 2:** 150 mA ... 4 A ... 5 A.

**Battery 3:** 100 mA ... 1 A ... 2 A.

### Confirm value:

Press **enter**

### Interrupt:

Press **esc**

### Note:

The actual discharge current may be lower than the value set, depending on the number of cells.

When the discharge load resistance is in use, the discharge current may be higher than the value set if the Ohm value of the discharge load resistance does not permit a lower current value. The minimum discharge current can be calculated from the formula:  $I = U / R$ . Example: a "pushed" 6-cell pack when freshly charged has a voltage under load of slightly less than 8 V. With our standard 0.40 Ohm discharge load resistance this produces a minimum discharge current of:  $7.8 \text{ V} / 0.40 \text{ Ohm} = 19.5 \text{ A}$ .

The ecolader software does not switch on the external discharge load resistance when battery voltage is above 10.5 V to guard against overload.

## 8.17 Min. discharge voltage

### Description:

This function is used to set the termination voltage of your battery during the discharge process.

### Activating the menu point:

Press the **akku x** button

### Select value:

Press the **+** or **-** button.

### Value range:

#### automatic:

The ecolader calculates the final discharge voltage from the number of cells in the pack and the discharge current in use.

#### or:

**Battery 1, Battery 2:** 500 mV ... 10 V

**Battery 3:** 1 V ... 10 V

in 500 mV increments

### Confirm value:

Press **enter**

### Interrupt:

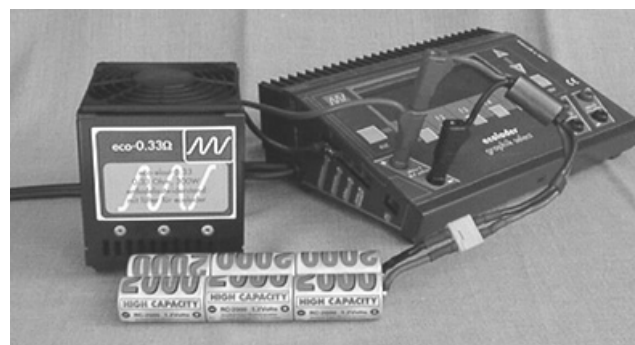
Press **esc**

### Notes:

If you are using the fixed limit values you may have to enter different limit values with different numbers of cells and different discharge currents.

For a given number of cells, the automatic circuit sets the termination voltage lower the higher the discharge current is set. The baseline voltage for the calculation is 0.7 V/cell.

In the automatic setting the calculated termination voltage can be read off during or after the discharge (and charge) process in the top line of the LCD screen when you call up the menu point.



Connecting the discharge resistance and batteries



## 8.18 Correcting the cell count

### Description:

This function allows you to override the ecolader's automatic cell count calculation. The number of cells, as calculated by the ecolader automatically, or corrected manually by the operator, is transferred to the **winsoft** software and is used for battery analysis.

### Activating the menu point:

Press the **akku x** button.

### Select value:

Press the **+** or **-** button.

### Value range:

1 cell ... 6 cells ... 8 cells

### Confirm value:

Press **enter**

### Interrupt:

Press **esc**

### Notes:

The calculated cell count is used by the automatic charge termination system to determine the actual termination sensitivity, and to calculate automatically the final discharge voltage in the discharge process.

It is true that a slight mis-calculation in the cell count makes it impossible to detect significant capacity differences during the discharge process, as the termination usually occurs in the steeply falling section of the voltage curve.

In the case of deep-discharged cells the cell count is automatically corrected repeatedly in the last few minutes of the charge process.

If you manually correct the cell count after connecting the battery to the charger, the unit will not make any further automatic corrections.

## 8.19 No. of cycles of combination program

### Purpose:

**Tired** batteries have to be "got into training" by repeated charge / discharge cycles. If a pack is to be revived completely, the number of cycles should be set higher or lower depending on the age and condition of the pack.

### Description:

This function is used to set the number of cycles the combination programs xxx\_DC (see Section 8.15.6) and xxx\_CD (see Section 8.15.7) are to complete during their course. One cycle consists of two phases: first the charge, then the discharge, or first the discharge, then the charge phase.

### Special feature:

The process of repeating the program "X" times is concluded when the charger determines no further rise in capacity during the discharge process. In any case it finishes after 9 cycles.

### Activating the menu point:

Press the **akku x** button.

### Select:

Press the **+** or **-** button.

### Select range:

1 x ... 9 x (9 x = X times function)

### Confirm select:

Press **enter**

### Interrupt:

Press **esc**

### Notes:

The xxx4DC program consists of 8 phases: 4 discharge phases (1, 3, 5, 7) and 4 charge phases (2, 4, 6, 8). The ecolader select transfers the number of the phase to the comment segment of the **winsoft** software, where it appears as a title to the diagram. The number of the phase appears in brackets in the status display during the charge / discharge process. (hold the **akku** button pressed in for one second).

If you are using a combination program the charge time limit or the charge quantity limit still apply - but for each phase separately! After all, a 2000 mAh pack can still only absorb 2 Ah after three discharge / charge cycles, and not 6 Ah.



## 8.20 Program after Power-On Reset (POR)

### Description:

This function is used to set your choice of default program, i.e. the program which is selected when you initially connect the ecolader to the car battery.

### Activating the menu point:

Press the **akku x** button.

### Select:

Press the **+** or **-** button.

### Select range:

All programs as described in Section 8.15.

Default setting battery 1+2: **Auto C**

Default setting battery 3: **Fix C**

### Confirm select:

Press **enter**

### Interrupt:

Press **esc**

### Special features:

#### Menu point "last":

If you choose "last" the charger will set the program which was last used, i.e. was in use before you disconnected it from the car battery), when you connect the unit to the car battery next time.

#### "Sel.CD" program:

This program is not available as a default after POR, and must be selected explicitly (see Section 8.15).

## 8.21 Default values

### Description:

This function allows you to enter settings for charging batteries and for using the ecolader which you have found to be ideal for your purposes.

### Select:

The settings are battery-specific, and are made using the three **akku x** buttons and the **spezial** button.

#### battery 1:

Max. charge time	50 min
Max. charge quantity	3000 mAh
Termination temperature	45° C
Termination delay	8 min
Termination check count	3 x
Termination sensitivity	3 mV/cell
Termination criterion	Peak
Charge method	Linear charge
Max. charge current	6 A
Charge / discharge program	Auto C
Max. discharge current	6 A
Final discharge voltage	automatic
Cycle count of combination program	1
Program after POR	Auto C

#### battery 2:

Max. charge time	50 min
Max. charge quantity	3000 mAh
Termination temperature	45° C
Termination delay	8 min
Termination check count	3 x
Termination sensitivity	3 mV/cell
Termination criterion	Peak
Method of charging	Linear charge
Max. charge current	4 A
Charge / discharge program	Auto C
Max. discharge current	4 A
Final discharge voltage	automatic
Cycle count of combination program	1
Program after POR	Auto C

**battery 3:**

Max. charge time	50 min
Max. charge quantity	1000 mAh
Termination temperature	45° C
Termination delay	8 min
Termination check count	3 x
Termination sensitivity	1mV/cell
Termination criterion	Peak
Charge method	Linear charge
Max. charge current	1 A
Charge / discharge program	Fix C
Max. discharge current	1 A
Final discharge voltage	automatic
Cycle count of combination program	1
Program after POR	Fix C

**special:**

Max. primary current	20 A
Min. car battery voltage (Umin.)	11.2 V
Light	flashing
Buzzer	on
LCD mode	One-Batt-Screen

**Display / select default settings:**

Press **enter** to accept default setting  
(screen shows: "executed")  
Press **esc** to interrupt.

**8.22 Max. primary current****Description:**

This function avoids your car battery being overloaded (when the voltage falls to an unacceptable level); can also be used to prevent overloading a mains PSU.

**Mains PSUs** may only be operated within their stated continuous load capacity (the lower value in the specification for the PSU) which is specific to that unit.

If you ignore this, there is a danger that the mains PSU will overheat, or its output voltage will collapse under severe load. As a rule the ecolader carries out a Reset in this situation, i.e. it acts as if it had just been connected to the car battery, and then "hangs" at the self-test stage since batteries are already connected to it.

In the worst case the ecolader may "hang" at full charge current, and in this situation it is very likely to wreck your valuable batteries.

You can avoid such a disaster by setting an input current (primary current) which suits your mains PSU, i.e. you limit the ecolader's current drain.

**Bear** in mind that the ecolader itself consumes a small idle current, and this must also be included in the calculation.

**Also** remember that a limit placed on the primary current means that the full level of current pulses will not be achieved if you use pulsed charging.

**Method of working:**

If the permissible primary current is exceeded, the charge current is reduced to a lower value.

If several batteries are connected to the unit, the current to all batteries is reduced equally.

**Any** current reduction is only restored when you disconnect a battery.

**Any** current reduction is not restored when a battery reaches the fully charged stage.

**The** current does not change if a battery is at the "full detection" stage (a, b ... on the screen). If you connect a new battery at this stage, the battery charger ignores it initially!

**Activating the menu point**

Press the **spezial** button

**Select:**

Press the **+** or **-** button

**Select range:**

5 A ... 20 A ... 22 A

**Confirm select, or interrupt:**

Press **enter** or **esc**

**Note:**

A reduction in primary current manifests itself in particular when you select pulsed charging, as the unit then limits the peak current drain instead of the average current drain.



## 8.23 Car battery min. voltage

### Description:

The purpose of this function is to avoid discharging your car battery excessively.

**Deep-discharging** causes long-term damage to the battery, and could also mean that your car engine will not start at the end of the session.

### Activating the menu point:

Press the *spezial* button.

### Select value:

Press the + or - button.

### Value range:

10.4 V ... 11.2 V ... 11.6 V  
in 100 mV increments

### Confirm value:

Press *enter*

### Interrupt:

Press *esc*

### Notes:

The default value is preceded by an asterisk.

The range of values stated above represents the voltage limit below which the ecolader beeps at you slowly to draw your attention to the low battery voltage.

If the battery voltage falls to more than 0.5 V below the selected voltage, all charge and discharge processes are halted.

### Display:

If the battery reaches the set low voltage limit the ecolader shows the following:

**Carbattvolts=MIN**

and beeps at 2-second intervals.

If it falls by a further 0.5 V (500 mV) the screen shows the following message:

**Carbattvolts<MIN**

and the buzzer beeps insistently.

You can read off the discharge / charge quantity for the batteries by pressing the *akku 1*, *akku 2* or *akku 3* buttons. At this point it is no longer possible to display the charge termination voltage or the discharge / charge time.

## 8.24 Light and buzzer

### Description:

This function configures the internal buzzer to alert you that the battery is full or empty.

You can also configure the flashing light output on the left side of the case to act as a "charged / discharged" indicator.

### Light:

The ecolader can operate a car flasher bulb (12 V / 24 W) connected to the flasher output in two ways:

**Flashing light:** the bulb is switched on and off alternately at one-second intervals when the battery is fully charged or discharged.

**Continuous light:** the bulb is switched on continuously when the battery is fully charged or discharged.

### Buzzer:

The internal buzzer can be switched on or off to indicate that the pack is full or empty.

The internal buzzer cannot be switched off by button when used as an audible reminder.

The buzzer is switched off automatically after about 30 seconds.

### Activating the menu point:

Press the *spezial* button.

### Select value:

Press the + or - button.

### Value range:

All combinations stated above.

Default values: flashing light, buzzer on.

### Confirm value:

Press *enter*

### Interrupt:

Press *esc*

### Note:

If you want to switch off the light and/or buzzer immediately when it is turned on, simply press any button.

### Circuit-breaker:

The ecolader includes an electronic circuit-breaker which interrupts the lamp current in an overload situation. To reset the circuit-breaker disconnect the cable to the flashing light, and allow the circuit-breaker to cool off. Remove the cause of the overload before connecting it again.



## 8.25 Displaying the serial number of the charger

### Description:

The purpose of this function is to provide information only. For example, it allows the

software to determine which version of the circuit board is fitted, so that any special hardware features can be taken into account.

## 9 LCD monitor displays

### Method of charging:

"L" Linear charge (L only 5 pixel high)  
 "P" Pulsed charge (p only 5 pixel high)  
 "f" Refresh charge (f only 5 pixel high)

### Termination criterion:

"^" Peak termination activated  
 "°" Temperature termination activated  
 "45°M" Termination temperature (Max, at 'ready')  
 "28°C" Sensor temperature (during charge)  
 "A4.20V" Final discharge voltage (Automatic)  
 "F4.50V" Final discharge voltage (Fixed volt.)  
 Time symbol 7<sup>00</sup> Start at time  
 \_\_\_\_\_ Place-holder (temp. or delay display)

### During charging or discharging:

**Time** [Min. : Sec.] / [Hours h Min.]  
**Voltage** [Volts]  
**Current** [Amperes]

### After the time display:

"a", "b"... "full" probability  
 "f" (inverse, flashing) indicates "full"  
 "e" (inverse, flashing) indicates "empty"  
 "t" for trickle charge

### Before the current display:

"!" Measurement pause during charge  
 "\*" reduced due to overheating danger  
 "" reduced due to excess batt. voltage  
 ", " gradual reduction in "Auto-D"; final discharge voltage reached

"#" reduced due to primary current limit  
 "<" reduced, current < nom. value (status)

### After full / empty termination:

"EMPT" final discharge voltage reached  
 "PEAK" voltage peak detected  
 "TEMP" excess temperature  
 "QUAN" charge quantity exceeded  
 "TIME" time exceeded

alternating with charged-in or dis-charged capacity in Ah.

"Rpol" reverse polarity battery!  
 "Sdis" connect temperature sensor!  
 "Vmax" battery voltage too high: Too many cells connected, or cells with excessive internal resistance, or car battery voltage too low for number of cells.

### Status display:

**During** the charge / discharge process press a **akku** button for at least 1/2 second to display current status for about 3 seconds.

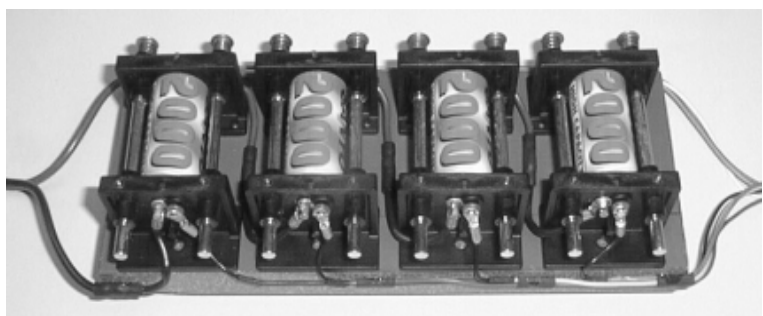
**Important** in combi-programs (..DC/..CD): the number in brackets indicates the discharge / charge phase. Example: the ...2CD program has four phases (1) charge, (2) discharge, (3) charge, (4) discharge.

**Simultaneously** the charge / discharge quantity is displayed (see also Section 6.1).

Professional selection unit for single cells (see Section 10.6)

To compensate for the higher transfer resistance of the clip connection, four cells are each measured with two "zero-current" sensing connections. This is known as a 4-pole measurement.

To achieve a 20 A discharge current, our discharge load resistance must be used with 0.30 Ohms.





## 10 Auxiliary sockets (pins on side of case)

On both sides of the charger's case you will find a double row of pins for the connection of auxiliary devices

[\*] ecolader select only

### 10.1\* Discharge load, left side of case

The discharge load resistance is designed to allow discharge currents of more than 10 A; the internal current sink permits a maximum discharge current of no more than 10 A.

The currents drawn by the external resistance vary with the voltage of the pack to be discharged. For this reason the internal discharge current sink is coupled with the external resistance for discharging. For example, it very accurately holds the total discharge current constant as battery voltage falls.

The value of the external discharge resistance has been chosen to ensure that a 6-cell pack can be discharged at a constant rate of 20 A until it is completely flat. Since a fully charged 6-cell battery will cause a current of just on 20 A to flow through the external resistance, this represents the lowest discharge current for 6 cells, even if you set 12 A or 15 A.

The resistance should not be less than 0.40 Ohm / 300 Watts for discharging 6 cells.

The load resistance is always connected in parallel to the battery to be discharged, provided that you have set a discharge current higher than 10 A, and that a discharge program has been selected.

Caution: standard commercial resistances will reach a temperature much higher than 100° C, and this presents a danger of fire or skin burns, and also of short-circuits if the resistance features exposed windings. For this reason use resistances with a case which prevents skin-contact, and which are either fitted with a cooling fan or can dissipate excess heat through a large-area ribbed heat-sink (accessory).

**Connections:** connect the 10-pin plug to the pins on the side, and connect the red banana plug to the positive socket of the **akku 1** charge socket (see photo on page 22).

### 10.2 Flashing light output, left

**For** connecting a 12 V / 25 W car flasher bulb to provide visual indication of a full or discharged battery.

**The** active flasher output (and the buzzer) is switched off when you press any of the 9 buttons on the charger.

**Max. load** up to 12 V / 21 W (approx. 2 A).

#### Circuit-breaker:

**The** ecolader includes an electronic circuit-breaker which interrupts the lamp current in an overload situation. To reset the circuit-breaker disconnect the cable to the flashing light, and allow the circuit-breaker to cool off. Remove the cause of the overload before re-connecting it.

### 10.3 Fan output, left

**For** connecting a 12 V battery cooling fan. The output is polarised.

It is connected permanently to the car battery supply, i.e. it is not switchable.

Max. load 12 V / 5 W (approx. 0.4 A).

**The** fan output is connected to the same circuit-breaker as the flasher output (see Section 9.2).

### 10.4 Temperature sensor, left (cal on eco+)

**For** connecting the temperature sensor (LM335Z) supplied with the charger.

### 10.5\* PC socket, left

**For** connecting to the serial (COM) interface of a compatible PC via the interface cable (with 9-pin sub-D connector) supplied.

**If** your vacant serial port on the PC has a 25-pin socket, use a 9 -> 25-pin mouse adaptor.

**See** also Section 10: data interface.

### 10.6\* 8-channel 12-bit A/D converter, right

**For** selecting individual cells it is important to obtain accurate voltage information on each separate cell in a pack when it is discharged at a high rate, preferably 20 A.

**This** is possible with the ecolader select, as it provides a means of connecting 8 measurement wires to factory-assembled packs (up to 7 cells), and of producing the high discharge current using an external load resistance.



## Connections to saddle ("hump") packs:

An ideal method of connecting the individual measurement wires in the case of factory-made saddle packs is to use the small sockets which are designed to accept the discharge resistances for the individual cells.

**Alternatively** you can make up a saddle pack discharge box precisely for this measurement task, by soldering a measurement cable to the pairs of contacts which are located over each cell connector.

**Caution:** it only makes sense to use factory-assembled soldered packs for this purpose; the transfer resistances are too high for measuring individual cells.

## Connections to battery "sticks":

If your stick packs are not fitted with discharge sockets, you can "make do" by soldering the measurement wires to pins, and slipping the pins under the heat-shrink sleeve.

## Single cells:

**Single cells** should be clamped together in the form of sticks, fitting a plate (ideally consisting of woven copper cell link braid) between the cells. The measurement wires are soldered permanently to these plates.

**The** cells can be supported in a U-shaped or V-shaped channel, for example. Even better, cut slots in a plastic tube to line up with the cell joints, fit the metal plates in the slots and press the cells together with a spring (see photos on page 30).

## Fitting the "sensor wires":

If only one measurement wire is used between the cells to pick up the voltage, the contact from cell to cell must really be 100%, otherwise any slight contact resistance will be assumed to be cell resistance, and the measurement will be incorrect. For 4 cells you can use two wires per cell, which should be connected in the sequence shown in brackets (see page 27).

## Sequence of measurement wires:

**The** order of the measurement wires should be coded using different colours, as it is essential to maintain the correct sequence, so that the PC analysis software (**winsoft**) can show the correct voltage for each cell in the pack.

**The** colours of the wires are based on the colour code for electronic components which is in standard use throughout the world:

(exception: wire 7).

0: <b>black</b>	cell 1 -	4 cells: (cell 1 -)
1: <b>brown</b>	cell 1 +	(cell 1 +)
2: <b>red</b>	cell 2 +	(cell 3 -)
3: <b>orange</b>	cell 3 +	(cell 3 +)
4: <b>yellow</b>	cell 4 +	(cell 5 -)
5: <b>green</b>	cell 5 +	(cell 5 +)
6: <b>blue</b>	cell 6 +	(cell 7 -)
7: <b>white</b>	cell 7 +	(cell 7 +)

**4-cell** mode: cells 2, 4 and 6 absent.

**The** black wire 0 must make very good contact with the pack as it carries the power supply to the 12-bit A/D converter.

**Wire** No. 7 is a special case: between the black and white wires the voltage of the entire 7-cell pack can be measured. The **winsoft** program assumes this to be the case.

If you wish to measure batteries consisting of fewer cells, then this white wire must also be connected to the positive terminal of the last cell to transfer the overall voltage of the pack in every case.

**This** even applies to packs of cells when you only wish to measure the overall voltage.

**With** high-current charge processes in particular, the ecolader is not able to determine and display the exact voltage of a battery, due to the cable resistances inside and outside the charger. If you require exact voltage values, you must use the 12-Bit measurement procedure. i. e. you should connect the black measurement wire to the negative terminal of the first cell in the pack, and the white wire to the last cell in the pack.

If you use the 4-point measurement method (using the cell holder shown on page 27) you may find that "cells" 2, 4, and 6 exhibit a low voltage when the pack is on charge. These values are due to the transfer resistance of the clamp connection.

**To** ensure that all measurement results are reliable and reproducible, the voltage data is not transferred via the 8 measurement wires if more than one battery is connected to the ecolader select.

**To** avoid error messages (Voltage > MAX) when the sensor wires are connected, it is important when discharging or charging always to connect the negative terminal of the charge cable first, followed by the positive terminal, when the sensor wires are connected.

**You** will obtain false measurements of the last cell in the pack if the battery is measured during a charge process and not, as is usual, during a discharge. The car battery / mains PSU voltage must not exceed 12 V.



### 11\* Data interface

The ecolader select transfers important charge and discharge data to the PC at one-second intervals when "on-line".

To receive and analyse the data your PC must be loaded with our **winsoft** software, and the ecolader select must be connected to the PC using our interface cable (**isl 8-RS232**). Both are included with the ecolader select.

The following data is transferred:

- battery number,
- charge time in seconds,
- charge / discharge voltage in mV,
- charge / discharge current in mA,
- Temperature of the temperature sensor.

If only Battery 1 is connected, the voltages are also transferred which are picked up by the 8 measurement wires:  
Cell 1... cell 7 and the overall voltage of all the cells.

The ecolader select also transfers a special set of incidental data at the start of the charge or discharge process, including the name of the program in use, date, time of day and cell count...

The exact data format and pin-outs for the interface connector are shown in the Specification in Section 14.

### 12\* "winsoft" Windows® Software

Using **winsoft** you can receive data from the **ecolader** select and the **isl 8** (a charger / discharger for up to 36 cells, specially designed for model aircraft use), and store the information globally or selectively for each battery in files in the computer. You can then read in the data again, display it in graphic form, compare graphs with each other on-screen, normalise voltages for the cell count, smooth curves, select combination program curves from an on-line data file, display energy statements for batteries, print out graphs (in colour), and much more.

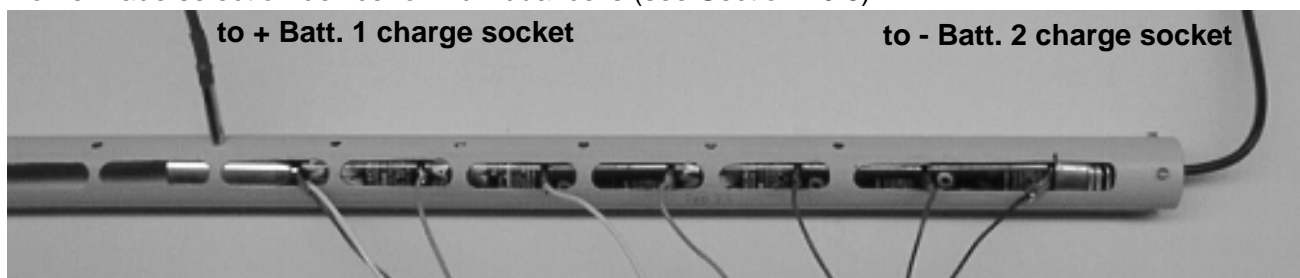
It is also possible to export the data to a spreadsheet program for further processing.

The Windows software runs on any computer using Microsoft DOS 6.22 and Microsoft Windows für Workgroups 3.11; it also usually runs correctly with the immediate predecessor versions.

Installation instructions are included in the **readme.txt** file on the 3.5" diskette supplied with the charger.

The operating instructions for our winsoft analysis program is integrated into the software's Help texts, which can also be printed out from within the program page by page.

Home-made selection device for individual cells (see Section 10.6)



Detail enlargement, + terminal



Detail enlargement, - terminal





## 13 Legal matters

### 13.1 Warranty

All **ecolader** chargers are carefully checked and tested before dispatch.

If you have a complaint, send the unit back to us with a clear description of the fault. A message such as "doesn't work properly" or "software error" doesn't help us much!

Before you send your **ecolader** back to us, please test the unit **carefully**, as it costs us money to test a charger, and if it turns out to be in working order we have to recover those costs from you. In this case it makes no difference whether the **fully functional charger** is returned within the warranty period or not. Approved warranty claims are processed in accordance with our currently valid General Conditions of Business, which are printed in our catalogue.

**One further note:** if a problem arises with any schulze product, send it directly to us without interfering with it in any way.

This ensures that we can repair the unit quickly, pick up warranty faults without any dispute, and keep costs to a minimum.

You can also be sure that we will fit genuine replacement parts which will work properly in your unit. Unfortunately we have had bad experience with third-party Service Centres which claim technical competence. Note also that any out-side interference with our products invalidates the warranty. Incompetent attempts at repair can cause further damage. We often find it impossible to estimate the repair cost of devices in such condition, and in certain circumstances we are then obliged to decline to repair it altogether.

### 13.2 Limited liability / compensation

We at Schulze Elektronik GmbH are unable to monitor the observance of our assembly and operation instructions, our prescribed conditions and methods for installation, connection, usage and maintenance of our battery chargers. For this reason we cannot accept liability for loss, damage or costs which arise through the inappropriate use of our

products, or are connected in any way with such use.

Within the normal legal limits, our obligation to provide compensation, for whatever legal reason, is limited to the invoice value of that quantity of product immediately involved in the event which caused the damage. This does not apply if we are obliged to accept unlimited liability in accordance with mandatory law due to our deliberate or serious negligence.

### 13.3 CE approval

All **ecolader** units satisfy all relevant and mandatory EC directives: these are the EMF directives

- **89/336/EWG,**
- **91/263/EWG and**
- **92/31/EWG.**

The product has been tested to meet the following basic technical standards:

**Interference radiation:** EN 50 081-1:1992,  
**Interference susceptibility:** EN 50 082-1:1992  
**and/or** EN 50 082-2:1995.

You are the owner of a product whose design and construction fulfil the safety aims of the EC for the safe operation of devices.

The approval procedure includes a test of **interference radiation**, i.e. of interference generated by the charger. This charger has been tested under practical conditions at maximum load current and with the mostly used number of cells, and remains within the interference limits.

The procedure also includes a test of interference susceptibility, i.e. the extent to which the charger is vulnerable to interference from other devices. The test involves subjecting the charger to RF signals similar to those produced by an RC transmitter or a radio telephone.

#### Note:

If you encounter problems in using this device, please carry out the measures described in Chapter 16 before you decide that it is defective.



## 14.1 Specification

<i>all models</i>	<b>Weight</b>	<b>Size</b>	<b>Screen</b>	<b>Screen</b>
	approx. [kg]	approx. [mm]	[line x char]	[area]
	1.1	207 x 142 x 58	2 x 16	61x15mm
		<b>akku 1</b>	<b>akku 2</b>	<b>akku 3</b>
<b>No. of cells</b>		(1-7 <sup>1</sup> ) 4 - 7	(1-7 <sup>1</sup> ) 4 - 7	(1-8 <sup>1</sup> ) 4 - 8
<b>Charge / discharge currents</b>		0.3 - 10 A	0.15 - 5 A	0.1 - 2 A
<b>Charge / discharge power max.</b>		60 W	32 W	24 W
<b>for cell capacity</b>		0.3 - 5 Ah	0.15 - 2.5 Ah	0.1-1 Ah

### Tolerances, ecolader +

Current, Batt. 1 & 2: typ. 5%; max. 15% or 250 mA (whichever is the greater)  
 Current, Batt. 3: typ. 5%; max. 10% or 100 mA (whichever is the greater)  
 Voltage: typ. 5%, max. 10%

### Tolerances, ecolader select

Current, Batt. 1 & 2: typ. 3%; max. 5% or 200 mA (whichever is the greater)  
 Current, Batt. 3: typ. 5%; max. 10% or 100 mA (whichever is the greater)  
 Voltage: typ. 3%, max. 5%  
 12-bit ADC: typ. 1%, max. 3%

### Miscellaneous information:

[<sup>1</sup>] All charge outputs can be used with 1 cell or more provided that the charge current is at least 3 C and temperature monitoring is used for charging. Peak detection is too unreliable in such cases.

- Total power dissipation of > 60 W can result in system shut-down due to overheating.
- No-load current drain: approx. 200 mA
- Power supply: 11 - 15.2 V
- All data assumes a car battery voltage of 12 V ... 13.8 V DC
- Recommended car battery: 12 V / 36 Ah or larger; must be fully charged to charge 7 cells!
- Recommended mains PSU: 13.8V (required to charge 7 cells), ideally switchable to 12 V (recommended for charging 6 cells, as the ecolader stays cooler; current: 20/22 A.

## 14.2 Other features

- fully automatic charge current calculation, patent applied for
- All battery outputs can be used simultaneously
- All battery outputs suitable for Ni-Cd and Ni-MH batteries
- Safety charge termination after selectable charge times
- Safety charge termination according to selectable charge quantity
- Safety charge termination according to selectable temperature (selectable battery output)
- Low voltage warning, selectable within the range 10.4 - 11.6 V
- Low voltage shut-down at 0.5 V below warning threshold
- Electronic circuit-breaker in the + 12 V line for external connections

### ecolader select:

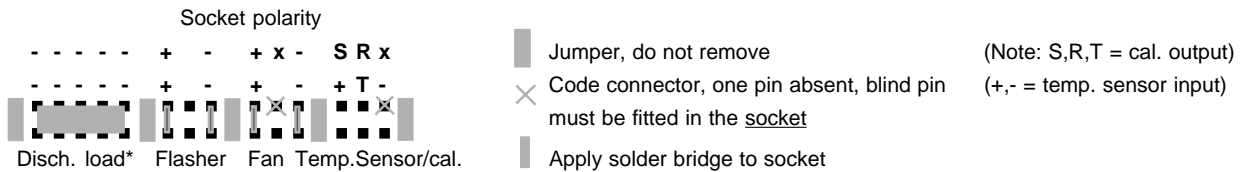
- Precision 8-channel 12-bit analogue-digital converter provides selection facility for individual battery cells
- Socket for external discharge load resistances (for 6-cell batteries preferably 0.40 Ohm, 300 W)

## 14.3 Default settings for battery programs and charger

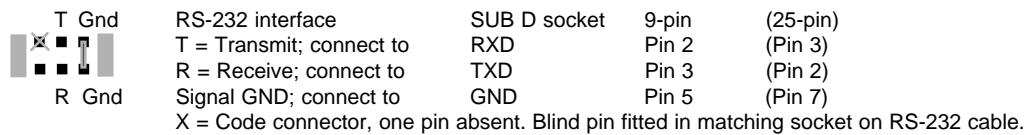
See Section 8.21; the default values are also underlined in the value ranges stated in the sub-sections of Section 8.



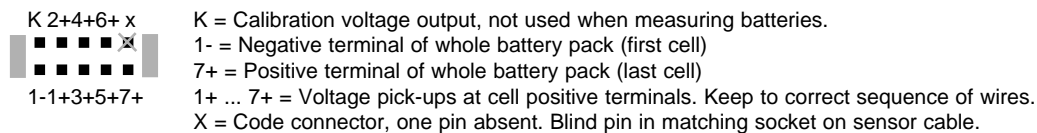
## 14.4 Pin-outs of auxiliary sockets, seen from solder side of sockets



## 14.5\* Pin-outs of PC interface, seen from solder side of socket



## 14.6\* Pin-outs of 8-channel ADC, seen from solder side of socket



## 14.7\* Data format, PC interface

Transmission speed: 9600 Baud

Data set in ASCII: **A:sssss:uuuuu:iiiiVSttt##**  
 ecolader select<sup>2</sup> ;U1;U2;U3;U4;U5;U6;U7;Ug;

Legend:	A	Battery No.
	sssss	Time in seconds
	uuuuu	Battery voltage in Millivolts
	iiii	Current in Milliampères
	V[:,-]	Current prefix
	S[l,L,E,t...]	Charge / discharge status
	ttt[-, ,0..9]	Temperature
	U1...7	12-bit cell voltage, 1-7 in mV <sup>2</sup>
	Ug	12-bit overall voltage, U1...U7 in mV <sup>2</sup>
	: or ;	Data separator

Comment set: **\* , Date, Day, Time, data source, battery No., program in use, current combination program phase, charge method in use, charge termination criterion, Cell count<sup>3</sup>**

[<sup>2</sup>] only if Akku 1 is in use alone

[<sup>3</sup>] calculated cell count, which may be corrected automatically by the charger within the first 10 minutes of the charge process. Left unchanged if manually corrected.



## 15 Error messages and their causes

If a limit value is exceeded (car battery voltage, charger temperature, maximum charge power), this results in some cases in interruption of the charge process (e.g. low car battery voltage), in others to a display of the cause of the error, and in others to the buzzer sounding; the buzzer is switched off automatically after a while.

- **After an error message** only the charge quantity is displayed; the charge time and charge voltage can no longer be read off.
- **After an error message** you must disconnect the ecolader from the battery voltage in order to re-set the unit to the normal working state.
- **At Akku 3:** if a battery voltage of less than about 0.5 V is detected, the charger assumes incorrect polarity.

**Error: Disconnect Batt2/3! and/or -Power-On-Reset-:**

**Cause:**

- a) Battery or batteries were connected to the charger before it was connected to the power supply.
- b) During a process the power from the car battery or mains PSU was interrupted, and was then switched on again (as a)).
- c) The "watchdog" circuit has tripped in the middle of a charge or discharge process. It trips when the micro-processor is brought to an unforeseen state, typically as a result of external interference.

**Note:** This is not an error. The charger is not capable of deciding whether a charge program or a discharge program should be used, whether a combination program is required or whether it should start from the beginning again, or even whether it would be harmful to charge an already fully charged pack at the set current.

- **For** technical reasons no error message is produced if one or more batteries are connected to the charger, but the charger is not connected to its power supply.

Error -#			Cause of error
B.1	B.2	B.3	battery-related
-	-	359	Converter voltage < min.
-	-	377	Converter power > max.
-	-	-	Batt. voltage > car battery voltage
161	261	361	Linear charge current > max.
162	262	-	Pulse charge current > max.
164	264	364	Discharge current > max
166	-	-	Internal disch. current > max.
168	-	-	External disch. current > max.
175	275	375	Power dissipation of linear charge power source > max.
176	276	-	Power dissipation of pulsed charge current > maximum
178	278	378	Power dissipation of discharge current sink > maximum

Device-related error	
Error-#	Cause of error
961	Charger current > maximum (Primary current drain greater than set)
962	Charger current > maximum (Current measurement via polarity guard greater than permitted)
962	External discharge current > maximum.
981	Charger temperature > maximum
983	Battery temperature higher than 65° C
904	Car battery voltage below minimum
5	Car battery voltage at minimum (warning)
906	Car battery voltage above maximum
9	Auxiliary connector circuit-breaker overloaded (warning)
99	Temperature sensor not connected



## 16 Fault-finding, fault correction

Dear customer,

If your battery charger does not appear to work as you expect it to, please run through the measures described below one by one.

If - and only if - you observe all these points, and the problem still persists, telephone us on Tuesday or Thursday for technical assistance. Even better, fill in the service questionnaire (on the next page) and send or fax it to us. We will then ring you back with our advice.

**From our many years' experience with battery chargers we know that most errors and faults can be avoided from the outset if you observe the measures outlined below.**

**If you send your charger to us and we find no defect - a situation which in most cases involves one or other of the causes described below - we are obliged to point out to you that we charge for our time in checking equipment that is found to be in perfect working order, even if the unit is still under warranty.**

1. Connect the charger to a fully charged car battery of at least 36 Ah capacity. Don't use a mains-powered PSU!
2. Be sure to use the original power cable to the power supply (with the original 4mm gold plated plugs), and at the car battery soldered 4mm sockets. Other types of connector, such as cheap banana plugs, car cigar lighter plugs etc. ... are not suitable! If you have made changes, kindly restore the original equipment. Soldered joints must be really sound - don't be satisfied with a bodged job.
3. The charge cables for all batteries should consist of 2.5 sq mm cross-section conductors. The charger's automatic current setting circuit is only able to set the ideal (high) charge current for your battery if it is using this heavy cable. You will be doing the charge termination circuit a real favour!
4. Just as important as the charge cables are the connectors attached to them. At the charger end please use 4 mm gold-contact connectors which have proved excellent in practice. Don't use expensive multi-contact plugs; in any case matching gold-contact connectors should also be fitted to your drive batteries and flight packs. Tin-plated connectors are simply not suitable as their contact resistance is high and they tend to produce intermittent contact in the long-term.
5. Provided that you adhere to the measures outlined under points 3) and 4) above, the fully automatic charge setting circuit should produce a charge current of at least 1 C and usually more than 2 C after about 5-10 minutes of charging a discharged pack. If this is not the case, then most likely the internal resistance of your battery is too high. Your battery has "had it", or is not suitable for rapid-charging.
6. Ensure that your battery pack contains no "dud" cells. When on charge any faulty cells usually heat up early, and then cause the automatic charge termination circuit to trip prematurely, and/or produce an excessively low charge current in automatic mode.
7. If you charge a pack at the Akku 1 or Akku 2 output using an automatic program, and the charge time is longer than three hours, then something is wrong with your charge cable, your connectors or your battery - perhaps too small a charge lead conductor cross-section? Or no high-quality gold-contact connectors? Maybe your battery is ripe for retirement, or is not suitable for rapid-charging at all.  
Establish the cause! Raising the maximum charge time limit is not the right route to take; in fact, if your charge times are close to one hour this usually indicates that something is less than ideal. The automatic current calculation circuit should set a charge current of 1 C after just 5-10 minutes!
8. Have you also read and observed the information in Section 1 (Warnings) and 2 (How to obtain reliable, trouble-free operation)?

