0804

Kraftelektronik AB

Users manual for charging rectifier type PCR

Manual 9-1576-C
P/n 0001046

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CONTENTS

APPENDIX

We retain the rights to make changes to these specifications without further notice.

1 PRESENTATION

Charging rectifier type PCR is a primary switched charging rectifier family with integrated monitoring unit.

The design is highly focused on safety of operation. An important design goal was that a single fault in the charging rectifier should not involve the risk of system power interruption. In first case, this implies that the charging rectifier must still be capable of sourcing the battery and the load. Otherwise, the charging rectifier must be able to at least warn for the hazardous situation in order to call for precautions to be taken. Practically, this means that certain circuits that functionally can be shared by the rectifier unit and the monitoring unit, has been doubled by safety reasons. Additionally, a number of "barriers" has been built in, in order to prevent different circuit parts to affect each other in case of a fault.

The strictly safety related thoughts also recurs in the built in functions. Among other things, it shows in well thought-out alarm functions, important regulation qualities such as temperature regulated float charging voltage along with an operators panel with an alphanumeric display based on an easily comprehensible and clear menu system and alarm indications using both light emitting diodes and text.

This description treats the usage of the charging rectifier and therefore, in first case, applies to operators personnel that is involved in the daily operation of the system, but also to all other personnel that has any reason to work with the charging rectifier.

For information about installation, starting up, service, maintenance and technical data, see the *Installation manual*.

The term "charging rectifier" will henceforth be substituted by the term "rectifier".

2 SAFETY INSTRUCTION

WARNING! This product contains dangerous voltage that, when touched, can cause electrical shock, burn or death.

Installation, service, maintenance and fault tracing may only be done by qualified personnel and according to the *Installation manual*.

Applies to rectifier in single phase version (type designation PCR1):

The rectifier cover may only be removed by qualified personnel and with the rectifier in dead condition. Other protective covers may only be removed by authorized service personnel.

Applies to rectifier in three-phase version (type designation PCR3):

The cover of the connection compartment may only be removed by qualified personnel. Other covers may only be removed by authorized service personnel.

See the *Installation manual* for the definitions of the qualification terms.

3 OPERATION

3.0 GENERAL

The information interchange between rectifier and the operator is basically made through an alphanumeric display, a few push buttons and a number of led-lamps. The display information is built as a menu system in a so called tree structure. On the display, information about system status, parameter settings, alarms etc, are presented. Further, you can adjust parameters for both installation and operation. All settings are done via the display menu system, which means that all operating devices like trimming potentiometers and similar are eliminated.

Some display functions and parameters concerns rectifiers in parallel operation and double DC systems. In connection to this there are some conceptions that will need an explanation:

When two or more rectifiers are connected for parallel operation, one is picked out as master while the rest will be slaves.

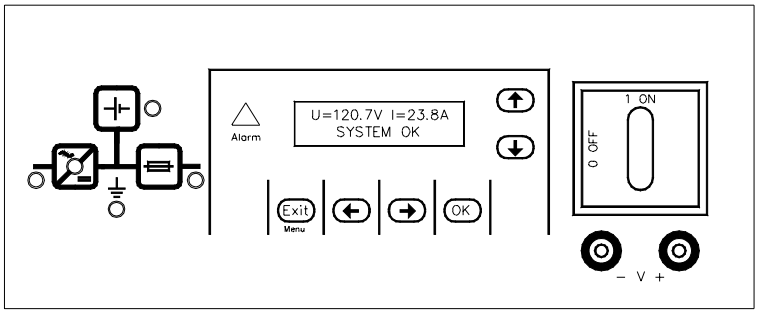
Also in double DC-systems, each system can contain rectifiers in parallel operation then divided into master and slaves according to above. As long as the systems are not connected, the will operate each as single systems. When connected they will cooperate mainly in handling of earth fault monitoring and battery circuit test.

For more details around parallel operation and double systems, see *Supplemental installation manual*.

3.1 OPERATORS PANEL

3.1.0 General

The panel contains a display, six push buttons, led-lamp for general alarm indication, five led-lamps for fault location and status indication, voltmeter terminals and mains switch.



Operator's panel for rectifier type PCR

3.1.1 Display

The display has 2 rows with 16 characters each. It is also provided with backlight for best readability in every condition of light.

3.1.2 Push buttons

The push buttons are used to control the menu system. Their functions varies in a certain amount depending on where in the menu system you are. In most cases, the display shows which push buttons that are relevant in every moment. The main tasks of the push buttons can be described as follows:

Exit-button
This push button has two functions as understood by the panel text.
One function is to change from main picture to the menu system, which explains the text "Menu" below the push button.

The other function is to undo a change and/or move backwards in the menu system, which explains the text "Exit". Moving backwards will at last end in the main picture.
Please note that this push button function is regarded as understood and therefore, it is never shown as an alternative in the display text.

Arrow left/right

These arrows are used to select menu alternative or parameters. The selected alternative is indicated by underscoring the first letter or last digit. When a left arrow is shown, the marker can only be moved to the left. When a right arrow is shown, the marker can only be moved to the right. And when both are shown, the marker can be moved both ways. The figure to the right shows how the display symbols looks like.

O.K.-button

The O.K. button is mainly used to confirm a selection or a setting. After each parameter change, you always get an extra opportunity to confirm with "OK" or undo with "Exit".
The O.K. button is also used to acknowledge alarms.

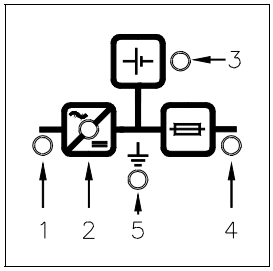
Arrow up/down

These push buttons have three alternative main functions.
The first is selection of main headlines in the menu system.
The other is selection of picture alternatives in already selected sub menu.
The third is changing value of a selected parameter.
These push buttons also have a built in stepping function which is handy when changing numerical values within large intervals. Keeping the push button pressed will soon start a rather rapid value stepping. Still keeping the push button pressed will after a while change the stepping to be slower but change the value in big steps instead.

3.1.3 LED lamp "Alarm"

The triangular indication light for alarm is turned off in its normal state.
A flashing red light indicates that there are alarms left waiting for acknowledge.
A steady red light indicates that there are alarms left that are acknowledged but still active, i.e the alarm condition is maintained.

3.1.4 LED lamps for fault location and status indication



A number of led-lamps are intermixed into the block diagram on the panel. The led-lamps indicates the status of each function respectively. Their main task is to make it easier to locate a fault. The led-lamps (numbered according to the figure) has the following meaning:

1, mains:	Green light	- Mains power is O.K.
	Red light	- Mains power fault.
	Off	- Rectifier is turned off.
2, rect:	Green light	- Rectifier is O.K.
	Red light	- Rectifier fault.
	Orange light	- Equalizing charging in progress.
	Off	- Rectifier is turned off.
3, batt:	Off	- Normal state.
	Red light	- Fault in battery or battery circuit.
4, distr:	Off	- Normal state.
	Red light	- Tripped fuse in distribution circuit.
5, earth:	Off	- Normal state.

Red light - Earth fault.

Which alarms that affects each led-lamp is stated in *appendix A, Alarm settings.*

3.1.5 Voltmeter terminals

In the voltmeter terminals, the battery voltage can be measured using an external voltmeter. The voltmeter terminals are mainly used for calibration of the rectifier measuring instrument.
Note: To avoid measuring faults, a high resistance voltmeter, 10MΩ or higher, is needed.

3.1.6 Mains switch

The mains switch disconnects the input mains power to the rectifier. The monitoring unit continues to work since it is power supplied from the DC side. Mains switch in off position is indicated on the display by the alarm "Switched off".

3.2 RECTIFIER ON/OFF

The rectifier can be turned on and off using the mains switch located on the operators panel. The monitoring continues to work even with the mains switch switched off. Mains switch in off position is indicated on the display by the alarm "Switched off".

```
U=120.7V I=23.8A
*SWITCHED OFF   OK
```

To protect certain circuits in the rectifier (current limiting resistors for capacitor charging), too frequent restarts must be prevented. If restarts are done too close to each other (<1min), the start will be delayed and the picture to the right will be shown in the mean time.

```
45s until start
   SYSTEM OK
```

3.3 MENU METHOD

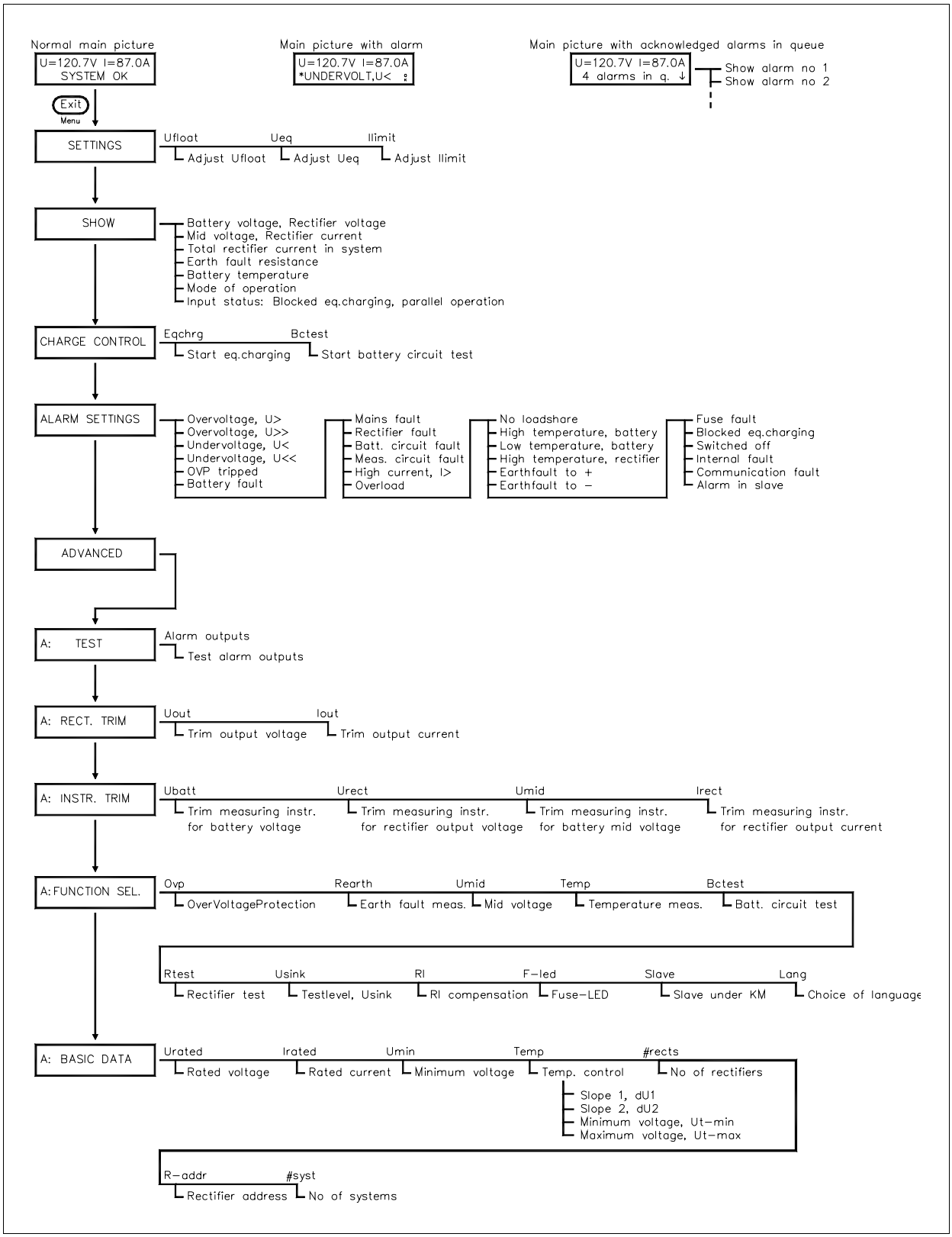
Information interchange between PCR and the operator is based on a menu system. Its structure is similar to a tree with a main picture in the root followed by a main menu dividing itself into submenus (branches).

You turn up and down the main menu using the push buttons "↓" and "↑". The submenus and other alternatives in a current picture are selected using the push buttons "↳" and "←" where selected alternative is marked with an underscore. Numerical values and setting alternatives respectively are changed using the push buttons "↓" and "↑".

The push button "Exit" is used to, on one hand move backwards one level in the menu system, on the other undo a setting. If you are in the main menu (i.e. one step below the main picture), "Exit" will cause a return to the main picture. If you leave the display in any other state than the main picture, an automatic return will be done within about one hour.

3.4 MENU SURVEY

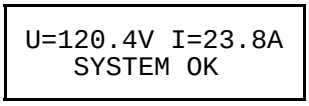
On next page, a complete survey covering all menu alternatives follows while the following sections of this chapter will describe the menu alternatives in detail.



Menu tree, PCR. Drawing no: 4-10741-B

3.5 MAIN PICTURE

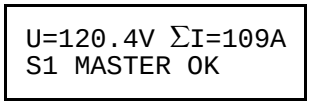
3.5.0 General

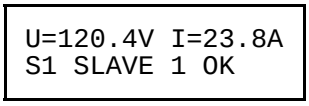


This picture is normally shown. Additionally, the display will automatically return to this state if no push button has been pressed during the last hour.

To the left shows actual battery voltage and to the right shows the rectifier output current. *SYSTEM OK* informs that everything is in order, i.e. no alarm conditions exists.

The push button marked "Exit/Menu" is in this state used to change to the main menu.





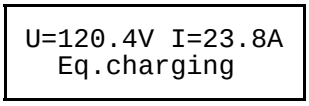
In systems with rectifiers in parallel operation, the display will instead of *SYSTEM OK* show the text *MASTER OK* or *SLAVE x OK* where x specifies the slave number (from 1 and up). If the rectifiers operates in double system, the system belonging is also shown as *S1* and *S2* for system 1 and 2 respectively.

In parallel operation, the master rectifier display will show the complete system current instead of its own current, as indicated by the summation sign. If the master rectifier is switched off or the communication with the slaves is interrupted by any other reason, the master will return to show its own output current. Then masters own current is always available via the menu *Show, Show midvoltage and output current*.

3.5.1 Normal float charging state

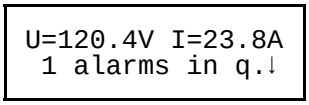
In a normal float charging state, the main picture is shown as above.

3.5.2 Other charging states



If any other charging state than normal float charging is in force, it is shown. The alternatives are "Equalizing charging" and "Testlevel, Usink".

3.5.3 Alarm



An alarm condition always starts with an alarm message waiting for acknowledge. This is further explained in section *Alarm messages* further on. As soon as all current alarms has been acknowledged, the message according to the figure is shown. It tells how many alarms that still remains in the alarm queue. With the push button "↓" , you can start to skim through the alarms in the queue. The alarm queue contains up to 20 alarms, unacknowledged counted. The alarms are sorted in time order starting with the latest alarm first in the queue.

3.6 MAIN MENU

The main menu contains the five main headlines *Settings, Show, Charge control, Alarm settings* and *Advanced*. With the push buttons "↓" and "↑" you change between the main headlines. Then press the push button "$^{O}_{K}$" to enter a main headline.

Some main headlines has sub-menus. In that case, select desired sub-menu before you press the push button "OK". Selected sub-menu is marked by an underscored first sign. Sub-menus are selected by using the push buttons "→" and "←".

Use the push button "Exit/Menu" to return to the main picture.

Under the main headline *Advanced*, another set of main headlines are concealed. They treat test functions, trimming possibilities and basic settings of functions and basic data.

In systems with rectifiers in parallel operation, all settings are done in the master rectifier, except for settings in the menues *Trimming of rectifiers, Calibration of measuring instruments*, the parameter midvoltage in the menu *Selection of functions* and the parameters rated voltage, rated current and rectifier address in the menu *Basic data*. The parameters are automatically copied to all slaves why they always will have identical parameter set. Each time you try to change a parameter directly in a slave, although it is intended to be set via the master, the warning message "Should be done via master" appears. The parameter will be changed at first, but after only a short while it is overwritten by the master setting.

WARNING! *The settings under the main headline* Advanced *are crucial for the rectifier operation. First carefully read the instructions in this manual. Then change settings only if you are absolutely sure of what you are doing!*

3.7 SETTINGS

3.7.0 General

Under the main headline *Settings* you adjust the rectifier output voltage at float charging and equalizing charging respectively and also the level for current limit of the rectifier.

```
   SETTINGS    ↓
Ufloat Ueq     →OK
```

```
   SETTINGS    ↓
Ilimit         ←OK
```

In systems with parallel operating rectifiers, these settings should be done via the master rectifier.

3.7.1 Adjust voltage level for float charging

Set the desired voltage level for float charging.

```
Adjust Ufloat
   120.4V   ↕OK
```

If the actual float charging voltage does not seem to fit according to the setting, it probably depends on temperature regulated float charging voltage. The setting you do is valid at +20°C.

WARNING! *The batteries may be damaged by an incorrect setting of float charging voltage. Always follow the recommendations stated by the battery manufacturer!*

3.7.2 Adjust voltage level for equalizing charging

Set the desired voltage level for equalizing charging.

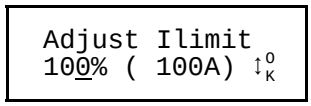
```
  Adjust Ueq
   124.7V   ↕OK
```

The voltage level for equalizing charging is an absolute level, i.e. it is not temperature regulated.

WARNING! *The batteries and the load may be damaged by an incorrect setting of equalizing charging voltage. Always follow the recommendations stated by the battery manufacturer and the specifications of the plant!*

3.7.3 Adjust current limit level

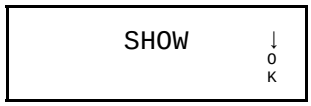
Set the desired level for the rectifier current limit. The level is set in percent of rated current, but is also shown directly in Ampere.



3.8 SHOW

3.8.0 General

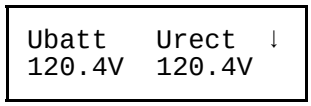
Under the main headline *Show* the system status in form of measurements and other operating conditions are shown.



This menu lacks sub-menus. Instead, all status pictures are placed one after each other directly below the main headline. Press "OK" and then skim through the status pictures using "↓" and "↑".

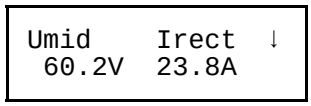
3.8.1 Show battery voltage and output voltage

Shows the battery voltage and rectifier output voltage.



3.8.2 Show mid voltage and output current

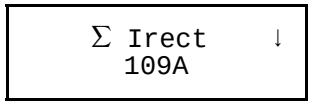
Shows battery mid voltage and rectifier output current.



If the mid voltage is not measured (see *Advanced, Function selection*), the measurement is replaced by "--".

3.8.3 Show summation of system current

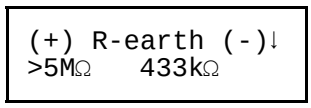
Shows the summation of system current, i e the sum of all rectifiers output currents.



This picture is only shown in master rectifiers in systems with rectifiers in parallel operation.

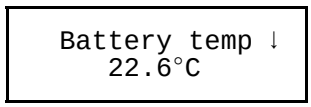
3.8.4 Show earth fault resistance

Shows the earth fault resistance to plus and minus directly in kΩ or MΩ. If the resistance exceeds 5MΩ, >5MΩ is shown instead.



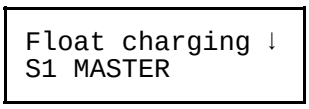
3.8.5 Show battery temperature

Shows the ambient temperature of the battery.



If the battery temperature is not measured, (see *Advanced, Function selection*), the measurement is replaced by "--".

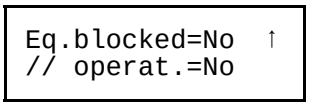
3.8.6 Show operational status



Shows the operational status of the rectifier. The alternatives is:
1) Float charging.
2) Equalizing charging. On second row, the remaining time is shown.
3) Battery circuit test.
4) Teststate, Usink.
5) Rectifier test. On second row, the remaining time is shown.

For additional information concerning the second row, see *Basic data, General*.

3.8.7 Show digital inputs



Shows the status for the two digital inputs, "Block/Disable equalizing charging" and "Parallel operation".

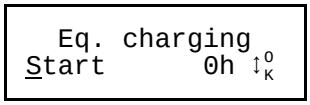
3.9 CHARGE CONTROL

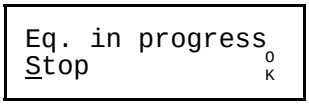
3.9.0 General

Under the main headline "Charge control", you can on one hand start and stop equalizing charging and on the other initiate battery circuit test.

These functions are blocked in slave rectifiers since it in parallel operation always is the master rectifier who should initiate these tests.

3.9.1 Start/stop equalizing charging



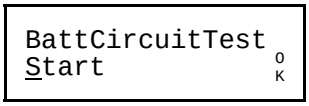


To initiate equalizing charging, you begin with setting the charging time in hours. Then press the push button "OK".

Present equalizing charging is stopped by pressing "OK".

WARNING! *Generally ,batteries of VR-type (vent regulated) should not be subject to equalizing charging. For some battery types equalizing charging could even be harmful to the batteries. Always follow the instructions stated by the battery manufacturer.*

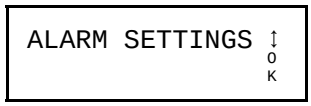
3.9.2 Manual battery circuit test



Battery circuit test is automatically performed within regular intervals (selectable via the menu *Advanced, Function selection*). But an extra battery circuit test can always be performed. In this picture you start the test by pressing "OK". The test is performed and the result is given.

3.10 ALARM SETTINGS

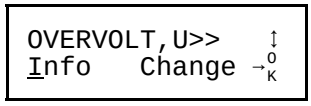
3.10.0 General



To every type of alarm belongs a set of adjustable parameters. Under the main headline *Alarm settings* you can read and adjust these parameters for each alarm type in the system.

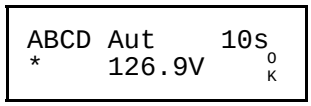
In systems with rectifiers in parallel operation, the alarm settings should be done via the master rectifier.

3.10.1 Alarm selection



You move between the different alarm types using the push buttons "↓" and "↑". When the desired alarm is found, you choose between just reading (Info) the alarm parameters or also making changes. The text given on the first row is the actual alarm text.

3.10.2 Read/Change alarm parameters



The shown picture is identical during both reading and changing, beside an underscored sign for selected parameter and some extra push button alternatives that is added when changing parameters. For parameter changing, select parameter with the push buttons "→" and "←" and change the parameter with the push buttons "↑" and "↓". The meaning of the different parameters is as follows:

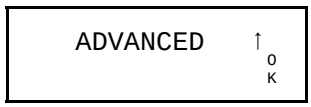
"ABCD" stands for each of the four alarm relays, A to D. Below each relay character you find either a star or nothing. A star means that the relay is activated in case of alarm. All combinations are permitted, from no relay at all to all relays at the same time.
Note that in case of a double system, alarm relay D is reserved for synchronization of battery test. Alarms accidentally connected to alarm relay D are in that case automatically sent to alarm relay C.

The alarm reset can be selected as either automatic return (Aut) or return after acknowledge (Ack). Automatic return is done as soon as the alarm condition cease to be valid. Return after acknowledge (also called "acknowledge demand") means on one hand that the alarm message remains until the alarm is acknowledged, and on the other hand that the alarm output relay is deactivated only if both the alarm condition has stopped and an acknowledge has been done.

Alarm delay is the time that must pass with the alarm condition fulfilled for the alarm to activate the alarm output relays and be qualified for acknowledge demand. An alarm that does not fulfill the alarm condition during the complete delay time disappears without a leaving a trace behind. The delay time can be set in 10:th of seconds, seconds, minutes or hours. It permits delay times from 0.1s to 63 hours. Number of time units and the time unit itself are set each individually.

The alarm level is the level that must be reached to trigger the alarm.

3.11 ADVANCED

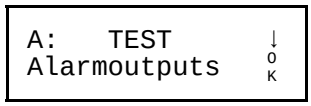


Under the main headline *Adva*nced, another set of main headlines is concealed. They concerns test functions, trimming possibilities and basic selections of functions and basic data. Every main headline under *Advanced* begins with an "A:".

WARNING! *The settings under the main headline* Advanced *are crucial for the rectifier operation. First carefully read the instructions in this manual. Then change settings only if you are absolutely sure of what you are doing!*

3.12 TEST

3.12.0 General



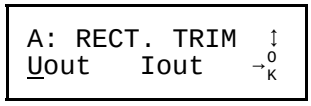
This test menu is aimed for testing the external alarm circuits without the need to invoke real alarms. Mainly, it is intended to be used during installation.

3.12.1 Test the alarm outputs

By using the push buttons "→" and "←" you select which alarm relay you wish to affect. With the push buttons "↑" and "↓" you change between normal and alarm state. When you leave the picture, the relays will reset to their ordinary state.

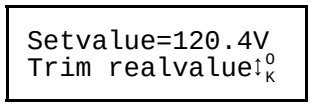
3.13 TRIMMING OF RECTIFIER

3.13.0 General



Under the main headline *Rectifier trim*, you can trim the actual output voltage and current limit level of the rectifier. This is already factory-set but should also be checked at the regular maintenance procedures that is stated.

3.13.1 Trim the rectifier output voltage

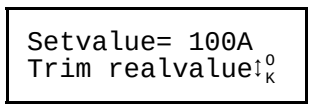


The intention at this state is to trim the output voltage of the rectifier so that it corresponds to the already set float charging voltage in menu *Settings*. As long as you stay in this picture, the rectifier will automatically adjust the output voltage to a level corresponding to +20°C battery temperature. Since some battery types in unloaded state can take some time to swing to final voltage, it is a good practice not to be in a hurry with the adjustment.

Connect a voltmeter to the panel measuring terminals. To avoid measuring faults, a high resistance voltmeter, 10MΩ or higher, should be used. Then use the push buttons "↑" and "↓" to trim until the voltmeter shows the same value as the setvalue on the display. Don't rush it. Give the control system and battery time to swing in.

Note that in case of parallel operating rectifiers, only one rectifier at a time must be switched on. In other case you will never know whose output voltage you are actually measuring!

3.13.2 Trim the rectifier output current



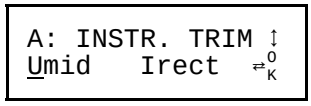
The intention at this state is to trim the output current of the rectifier so that it corresponds to the already set current limit in menu *Settings*.

Connect a current measuring instrument, e.g. a shunt resistor or a clamp meter, directly on the output cables of the rectifier. Connect a load that you know for certain will make the rectifier work in current limiting state. Then trim using the push buttons "↑" and "↓" until the current measuring instrument shows the same value as the setvalue on the display.

Note that in case of parallel operating rectifiers, only one rectifier at a time must be switched on. In other case the load sharing function may cause unclear information!

3.14 CALIBRATION OF MEASURING INSTRUMENT

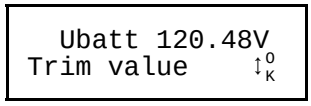
3.14.0 General



Under the main headline *Instrument trim*, you can calibrate the built in measuring instrument. This is already factory-set but should also be checked at the regular maintenance procedures that is stated.

Note that the voltmeter used for calibration should have an accuracy of 0.1% or better. The ammeter that is used for calibration should have an accuracy of 0.5% or better.
When calibrating measures, you trim one resolution step at a time which does not necessarily result in even decimals. The trim resolution is often higher than the display resolution why several trimming steps may be necessary before the display changes its value.

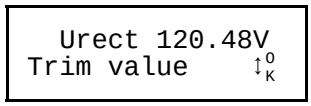
3.14.1 Calibration of battery voltage measuring instrument



In this state you calibrate the measuring instrument for battery voltage so that the measurement corresponds to the actual battery voltage.

Connect a voltmeter to the panel measuring terminals. To avoid measuring faults, a high resistance voltmeter, 10MΩ or higher, should be used. Then use the push buttons "↑" and "↓" to trim until the measuring on the display corresponds to the voltmeter.

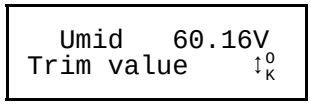
3.14.2 Calibration of output voltage measuring instrument



In this state you calibrate the measuring instrument for rectifier output voltage so that the measurement corresponds to the actual output voltage.

Connect a voltmeter close to the rectifiers output DC terminals. Then use the push buttons "↑" and "↓" to trim until the measuring on the display corresponds to the voltmeter.

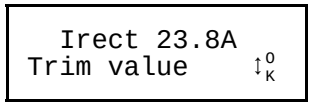
3.14.3 Calibration of battery midvoltage measuring instrument



In this state you calibrate the measuring instrument for battery mid-voltage so that the measurement corresponds to the actual battery midvoltage.

Connect a voltmeter from the battery minus pole, either to the point of measuring for battery mid voltage or to the terminal for midvoltage measuring on the rectifier. Then use the push buttons "↑" and "↓" to trim until the measuring on the display corresponds to the voltmeter.

3.14.4 Calibration of output current measuring instrument



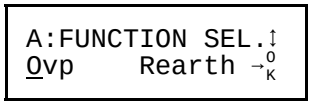
In this state you calibrate the measuring instrument for rectifier output current so that the measurement corresponds to the actual output current.

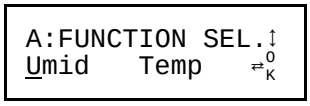
Connect a current measuring instrument, e.g. a shunt resistor or a clamp meter, directly on the output cables of the rectifier. The calibration should be done at a rather high current. Then use

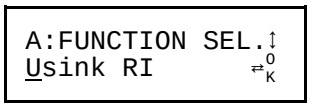
the push buttons "↑" and "↓" to trim until the measuring on the display corresponds to the current measuring instrument.

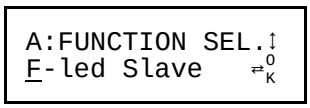
3.15 SELECTION OF FUNCTIONS

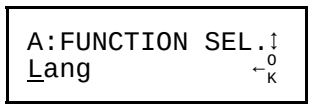
3.15.0 General







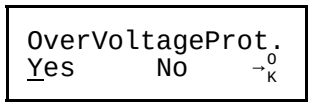




Under the main headline *Function selection*, you can select, on one hand which functions that should be used in the system, on the other the value of the corresponding parameters.

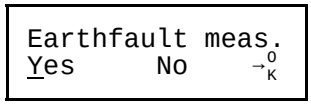
In systems with rectifiers in parallel operation, these settings, except midvoltage, should be done via the master rectifier.

3.15.1 Overvoltage protection



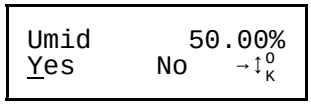
The overvoltage protection device, called OVP (Over Voltage Protection), is a protection device that turns off the rectifier in case of an overvoltage. The level is defined by the alarm with the same name. Here, you can chose whether this function should be used or not. If this function is dropped, both the corresponding alarm and shut down function are also disabled.

3.15.2 Earth fault measuring



In this state you can chose whether the earth fault measuring should be used or not. If the earth fault measuring is dropped, the earth fault alarm will be disabled and the input terminal for earth fault measuring will internally be galvanically separated. This is mainly used in case of the presence of another equipment for earth fault measuring in the system that must not be disturbed.

3.15.3 Midvoltage



In this state you can choose whether the battery midvoltage should be measured or not. If the midvoltage measuring is dropped, the alarm "Battery fault" loses its function.

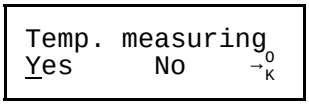
Since it's not always physically possible to make a connection to the theoretical midpoint of the battery, instead you have to specify where the connection is actually done. You do that by specifying in percent the amount of total battery voltage that is supposed to be found in the measuring point. First calculate the percentage value using the following formula:

Umid(%) = 100 * (number of cells below the measuring point) / (total number of cells)

Then set the calculated percentage value using the push buttons "↑" and "↓".

In systems with rectifiers in parallel operation, the setting of the location of the midpoint should be done via the master rectifier while selection of midvoltage measuring, yes/no, can be separately set in each rectifier.

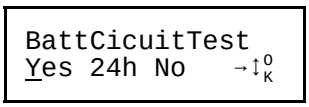
3.15.4 Temperature measuring



For measuring of the battery ambient temperature, an external temperature sensor must be installed (see the installation manual). In this state you can specify whether the sensor is installed or not. Without sensor, the both alarms "High temperature, battery" and "Low temperature, battery" loses their function. Additionally, you lose the possibility to use temperature regulated float charging voltage (see also *Basic data* further down).

In slave rectifiers, the temperature measuring is automatically dropped irrespective of the settings in this picture.

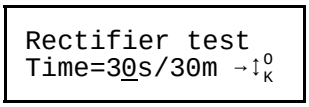
3.15.5 Battery circuit test



In this state you choose whether the function for automatic battery circuit test should be used or not. Without automatic battery test, the alarm "Battery circuit fault" loses its function, except for the manually initiated test that always will work.

Select desired test interval. The interval is specified in even hours.
If the test interval is set to an even number of twenty-four hours, it could be an advantage if the test is performed at a certain point of time every day. Such a synchronisation is made by, at the desired point of time, enter this picture and then leave it again using the push button "OK" (not "Exit").

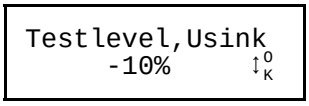
3.15.6 Rectifier test



This function only has meaning in systems with rectifiers operating in parallel.

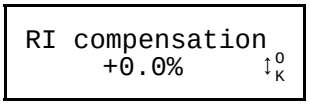
In parallel operation, the voltage level can be maintained by the other rectifiers, even if one is out of order. To make it possible to identify a faulty rectifier, a test is needed at regular intervals where only one rectifier at a time is in operation (see also the description for the alarm "Rectifier fault"). Test time (1-999s) and test interval (1-99m) is adjusted here.

3.15.7 Test level, Usink



In some automatic tests, such as battery circuit test and rectifier test, the output voltage is lowered relative the current float charging voltage (that may be temperature regulated). Here you set the amount of output voltage reduction (0-50%). Also compare to the parameter "Umin" in the menu *Basic data* further on.

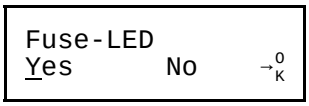
3.15.8 RI compensation



If you by any reason choose to connect the battery voltage measuring wires close to the rectifier instead of close to the battery, you may compensate for the resistive voltage loss that will affect the measuring by using the parameter “RI compensation”. Up to 3% of losses can be compensated. There is also a possibility to set the compensation slightly negative (-0.1%) which may make loadsharing easier in case of difficult circumstances.

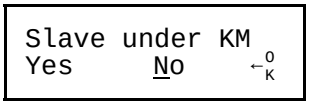
Compensation will only take place during currents exceeding 20% of rated current.

3.15.9 Fuse-LED



In the panel block diagram, there is a led-lamp indicating "Tripped fuse in distribution circuit". In some cases the input used for monitoring of distribution fuses is used for other purposes. In that case, choose "No", which means that the led-lamp will remain unaffected.

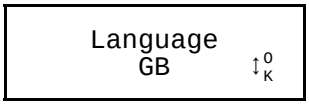
3.15.10 Slave under KM



The rectifier may work as a slave under monitoring units of the type KraftMaster. In slave state, a great deal of the monitoring functions of the rectifier are taken over by the KraftMaster unit.

Note: Should not be mixed up with the concept “slave rectifier” in systems with parallel operating rectifiers.

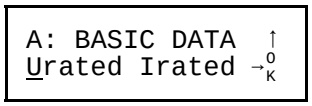
3.15.11 Language

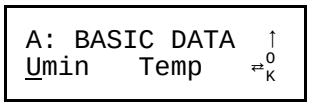


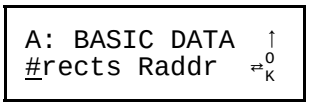
Here, you can select the language you wish to use on the display.

3.16 BASIC DATA

3.16.0 General

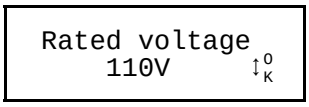






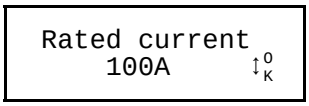
Under the main headline *Basic data,* you set a number of basic parameters that in principle are defined by the construction of the rectifier and other parts of the plant.

3.16.1 Rated voltage



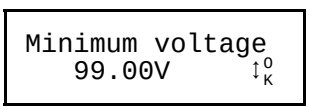
The rated DC voltage of the rectifier should correspond to the DC voltage rating found on the rating sign placed on the rectifier.

3.16.2 Rated current



The rated output current of the rectifier should correspond to the output current rating found on the rating sign placed on the rectifier.

3.16.3 Minimum voltage



There are a number of parameters that affects the output voltage of the rectifier such as temperature regulation, battery test etc. Consequently, it is not easy to be sure of how deep the voltage really can sink.

To guarantee that the output voltage never falls below a critical limit, you can here set a guaranteed minimum level. This setting then overrides all other parameters as the lower voltage limit.

In systems with rectifiers in parallel operation, this setting should be done via the master rectifier.

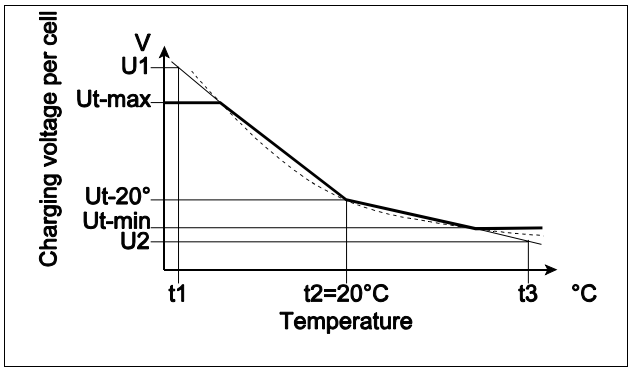
3.16.4 Temperature regulation

```
Temp.regulation
dU1    dU2    →K0
```

```
Temp.regulation
Ut-min Ut-max ⇄K0
```

The float charging voltage of the rectifier may be regulated by the battery temperature. One condition for this is that the rectifier is supplied with an external temperature sensor that measures the ambient temperature of the battery. The regulation parameters are based on specifications given by the battery manufacturer.

In the figure to the right, the charging curve according to a typical battery specification is shown as a dashed line. This curve is approximated into two straight lines with individual slopes (the thick line). Further, you can state an upper and lower limit for the temperature regulation, Ut_{min} and Ut_{max}. Do like this to decide the slopes of the two lines:



Charging voltage as a function of temperature

1. Get the charging curve recommended by the battery manufacturer.
2. Draw, with the help of a ruler a straight line from the 20° point at each way so that the curve is followed as accurate as possible.
3. Settle two points on the drawn lines that corresponds to as low and high temperature as possible, t1 and t3. Read on the voltage axis what the corresponding voltages are due to the lines you have drawn. That will give U1 and U2.
4. Calculate the two slopes dU1 and dU2 as follows:
   dU1 = number of battery cells * (U1 - $Ut_{20°}$) / (20° - t1)
   dU2 = number of battery cells * ($Ut_{20°}$ - U2) / (t3 - 20°)
   where the voltages U1, U2 and $Ut_{20°}$ are expressed in mV/cell.

As an example of typical values, the slopes per cell for a couple of common battery types are given. Note that the battery data may be changed by the battery manufacurer. These figures must therefore only be used as examples!
Multiply with number of battery cells to achieve results as above:

1. Tudor, type SGV: dU1/cell=4.60mV/°C dU2/cell=1.50mV/°C.
2. Tudor, type S4: dU1/cell=5.71mV/°C dU2/cell=3.75mV/°C.

If temperature regulation is undesired, then set dU1=0, dU2=0, Ut_{min}=”low”, Ut_{max}=”high”.

In systems with rectifiers in parallel operation all settings concerning temperature regulation should be done via the master rectifier.

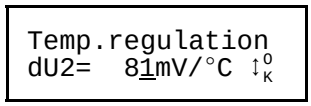
3.16.4.1 dU1

```
Temp.regulation
dU1= 248mV/°C ↕K0
```

Set the temperature regulation slope for temperatures below 20°C. Choose 0mV/°C if no temperature regulation is desired.

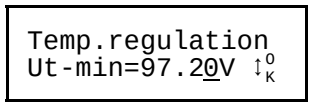
3.16.4.2 dU2

Set the temperature regulation slope for temperatures above 20°C. Choose 0mV/°C if no temperature regulation is desired.



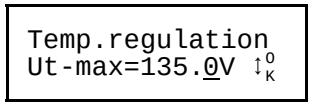
3.16.4.3 Ut-min

Set the lower voltage limit for the temperature regulation. Choose a very low limit if no limitation is desired. Also compare to the parameter "Minimum voltage" above.



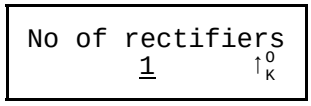
3.16.4.4 Ut-max

Set the upper voltage limit for the temperature regulation. Choose a very high limit if no limitation is desired.



3.16.5 Number of rectifiers

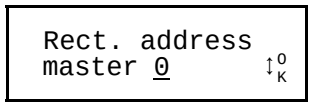
Set the number of rectifiers that are operating in parallel in the system.



In systems with rectifiers in parallel operation, this setting should be done via the master rectifier.

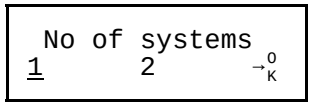
3.16.6 Rectifier address

Rectifiers that should be able to operate in parallel are interconnected through the local net KraftNet. To make the communication in the net possible, each unit must have a unique address. Set the address for this particular rectifier.



3.16.7 Number of systems (double systems)

A system may be described as an uninterruptible power system consisting of a rectifier (one or more in parallel), battery and distribution. The most simple plant has only one separate system. Then choose “Number of systems” = 1.



Some plants consists of two separate systems that can be joined or disjoined. In joined operation the two systems must cooperate in functions such as battery test and earth fault measuring. In this case you therefore have to choose “Number of systems” = 2. Note that alarm relay D in this case is reserved for other purposes (also see section *Alarm settings*).

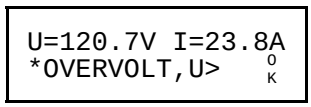
For more details regarding double systems, see *Supplemental installation manual*.

In systems with rectifiers in parallel operation, this setting should be done via the master rectifier.

3.17 ALARM MESSAGES

3.17.0 General

An alarm message consists of an alarm text on the lower display row, alarm status (delay, active or inactive) and the acknowledge demand. At the same time, the "Alarm"-lamp on the panel flashes until acknowledge is done. After acknowledge the "Alarm"-lamp continues to shine with a steady light until the alarm condition stops. All still active alarms are



gathered in the alarm queue where they can be studied at any time. The main picture tells how many alarms there are in the alarm queue.

It is always the latest alarm that is shown. As the latest alarms are acknowledged and thereby sent to the alarm queue, the next alarm in turn will turn up for acknowledge. Acknowledge by using the push button "OK".

3.17.1 Alarm during delay

```
U=120.7V I=23.8A
•OVERVOLT,U>    OK
```

Alarms can be delayed to suppress short and irrelevant variations. The delay only affects alarm indications such as led-lamps and alarm output relays. The alarm message itself on the display is always shown without delay.

A dot (•) as first sign indicates that the alarm is in delay state. The alarm can already be acknowledged. If the alarm condition stops before the delay time has expired, the alarm will disappear without a trace and regardless of possible acknowledge demands.

3.17.2 Active alarm

```
U=120.7V I=23.8A
*OVERVOLT,U>    OK
```

A star (*) as first sign indicates that the alarm is active. With active alarm means that the delay period has passed and the alarm condition is still maintained.

If the alarm is acknowledged, it will be moved to the alarm queue. If the alarm condition stops, the alarm will disappear provided there is no impose upon acknowledge.

3.17.3 Inactive alarm

```
U=120.7V I=23.8A
 OVERVOLT,U>    OK
```

A blank position as first sign indicates that the alarm is inactive. With inactive alarm means that the delay time has expired and the alarm condition has stopped but the alarm is imposed upon acknowledge.

The alarm will completely disappear after acknowledge.

3.17.4 Alarm queue

```
U=120.7V I=23.8A
 2 alarms in q.↓
```

```
U=120.7V I=23.8A
Queue is empty  OK
```

Acknowledged alarms that is still active are gathered in the alarm queue. When all alarms are acknowledged, the main picture therefore can look like the left box. Using the push buttons "↓" and "↑" you can skim through the alarms in the queue. If the alarm queue is emptied while skimming, this is indicated according to the right box. Now press "OK" to reset back to the original main picture.

3.17.5 Alarm descriptions

OVERVOLT, U>

Function: Monitoring of the upper limit of the float charging voltage.
Alarm cond: The system voltage exceeds the preset limit.
Interlockings: 1) The alarm is disabled during equalizing charging.
2) Always disabled in slave rectifiers.
Other: The limit is defined as voltage deviation (dV) from preset float charging level. If the float charging voltage is temperature regulated, the absolute level of the limit will also vary according to the temperature.

OVERVOLT, U>>
Function: Monitoring of the upper limit of the system voltage.
Alarm cond: The system voltage exceeds the preset limit.
Interlockings: Always disabled in slave rectifiers.

UNDERVOLT, U<
Function: Monitoring of the lower limit of the float charging voltage.
Alarm cond: The system voltage falls below the preset limit.
Interlockings: 1) During test with reduced output voltage, e.g. battery circuit test.
2) If the rectifier operates with an output current exceeding 90% of preset current limit.
3) Always disabled in slave rectifiers.
Other: The limit is defined as voltage deviation (dV) from preset float charging level. If the float charging voltage is temperature regulated, the absolute level of the limit will also vary according to the temperature.

UNDERVOLT, U<<
Function: Monitoring of the lower limit of the system voltage.
Alarm cond: The system voltage falls below the preset limit.
Interlockings: 1) During test with reduced output voltage, e.g. battery circuit test.
2) Always disabled in slave rectifiers.

OVP TRIPPED
Function: Catastrophe protection. Protects the load from harmful overvoltage by turning off the rectifier. The demand for at least 10% output current gives selectivity in systems with parallel operating rectifiers, i.e. only the rectifier that causes the overvoltage will trip.
Alarm cond: The system voltage exceeds preset limit at the same time as the rectifiers output current exceeds 10% of rated current.
Interlockings: The OVP function can be disabled in the menu "Function selection".
Other: As long as the alarm delay continues, the text "OVP level" will be shown. It then follows by "OVP TRIPPED".
After acknowledge of the alarm, the text "Restart using mains switch" follows. The rectifier then must be restarted, either using the mains switch or via the input for remote blocking.

BATTERY FAULT
Function: Compare the upper and lower halves of the battery by measuring the midvoltage.
Alarm cond: The difference between the midvoltage and the half of the system voltage exceeds preset limit (that is specified in %).
Interlockings: The midvoltage measuring and thereby also the alarm function can be disabled in the menu "Function selection".
Cause: 1) Damaged battery cell.
2) Irregular charging conditions. Equalizing charging may help.
3) Some types of vent regulated batteries may in fully charged and idling condition show a rather big amount of variation in cell voltage, although they are completely faultless.
Other: Due to uneven number of cells or that the battery blocks lacks measuring terminals for each cell, the measuring point will diverge from the actual midpoint. In the menu "Function selection", you set the percentage of total system voltage that corresponds to the measured midvoltage.

MAINS FAULT
Function: Monitoring of the mains supply and the rectifier bulk voltage.
Alarm cond: 1) Phase fault in mains supply.
2) Input mains voltage falls below about 260V (3-phase) and 150V (1-phase) respectively.

3) The internal bulk voltage falls below about 330V (3-phase) and 250V (1-phase) respectively. Also valid for transients such as ripple voltage.

Interlockings: 1) During switched off rectifier via the panel mains switch
2) During switched off rectifier via the input for external blocking.

Cause: 1) Mains supply fault.
2) Input diode bridge fault.
3) Transistor bridge fault.

RECT. FAULT

Function: Warns for a condition where the rectifier may not be able to maintain a fully charged battery.

Alarm cond: The charging voltage falls below the preset limit.

Interlockings: 1) If the output current is >90% of preset current limit.
2) During test with reduced output voltage (e.g. battery circuit test).
3) During mains fault.
4) During switched off rectifier, either via the mains switch or via the input for external blocking.

Cause: 1) Tripped DC output fuse.
2) Fault in connections and cablings.
3) Fault in the cooling of the rectifier. In that case combined with the alarm "High temp, rect".
4) Other internal rectifier fault which resulting effect is that full output power no longer can be maintained.

Other: With two or more rectifiers operating in parallel, such a fault will not easily be detected because the other rectifiers will maintain the voltage level even if one is eliminated. Therefore the following are done in parallel operation:
If a rectifier finds out that it delivers a very small amount of current (<3%), it could depend on two things. Either a very small load or a faulty rectifier. To establish which of them it is, the rectifier instructs the other rectifiers to reduce the output voltage to the level Usink (according to the settings in the menu "Function selection"). If the voltage in this state falls below the preset limit, the alarm condition is true. The alarm is active until either a further test turns out well or as soon as current begins to flow. A test in progress is immediately finished in case of a fulfilled alarm condition or if current begins to flow.
The interval between the tests and the maximum test duration is set in the menu "Function selection".
NOTE: During temperature regulation of float charging voltage, very high battery temperatures may cause such a reduction of the output voltage that the alarm "Rectifier fault" is activated.

BATTCIRCFAULT

Function: Testing of the complete battery circuit, i.e. cables, connections, fuses and battery.

Alarm cond: The charging voltage falls below the preset value while test is in progress.

Interlockings: -

Cause: 1) Connection or cable fault.
2) Tripped battery fuse.
3) Faulty battery.

Other: Due to its momentary nature, this alarm has to be set for acknowledge demand. Else it will never be detected.

MEASCIRCFAULT

Function: Testing of the circuits for system voltage measuring.

Alarm cond: The difference between measured battery voltage and internally measured rectifier output voltage exceeds the preset limit (stated in %).

Interlockings: -

Cause: 1) Measuring input for external battery voltage is not connected.
2) Measuring connection or measuring cable fault.

3) Improper calibration of measuring inputs. Calibrate according to the menu "Instr.trim".
4) Fault in the internal measuring circuits.

Other: If this alarm goes active, the rectifier is internally switched into regulation based on the rectifier output voltage instead of as normal, the battery voltage.

HIGH CURR, I>

Function: A warning of that the output current approaches the maximum capacity of the rectifier.
Alarm cond: The output current exceeds 90% of preset current limit.
Interlockings: -
Other: Since this is not regarded as a real alarm but more as information, no led-lamps on the panel are lit based this alarm. Yet, alarm relays are activated as usual.

OVERLOAD

Function: A warning of an overloaded rectifier.
Alarm cond: The condition for the alarm "High curr, I>" has been fulfilled during all of the preset delay time, which should normally be long (typically 24h).
Interlockings: -
Cause:
1) The battery has not reached full recharge during the preset delay time. It indicates that the size of the rectifier may be underestimated.
2) A gradually extension of the load has in the end raised a power requirement that exceeds the rectifier capacity.
3) Temporary overload due to some fault in the plant.

Other: The alarm is not visible during the delay period. The shortest delay time will be 1 minute, even if it is possible to set the time shorter.

NO LOADSHARE

Function: Tests if parallel operating rectifiers are sharing the load alike.
Alarm cond: The difference between output currents of this rectifier and the mean value of all rectifiers exceeds preset value (stated in % of mean current).
Interlockings:
1) During test with reduced output voltage (e.g. battery circuit test).
2) If the difference as above falls below 5% of rated current.
3) If mean current < 20% of rated current.
4) If the rectifier output current exceeds the mean current. If this should be a fault condition it will be noticed by an overvoltage alarm in due time.
5) During mainsfault.
6) During switched off condition.

Other: The shortest delay time will be 1 minute, even if it is possible to set the time shorter.

HIGHTEMP, batt

Function: Monitoring of the ambient battery temperature.
Alarm cond: The battery temperature exceeds preset limit.
Interlockings: The temperature measuring can be excluded via the menu "Function selection".
Other: An alarm will stop a possible equalizing charging.
In the temperature exceeds +49°C, the sensor is regarded as faulty. It is indicated by the alarm "Int. fault".

LOW TEMP, batt

Function: Monitoring of the ambient battery temperature.
Alarm cond: The battery temperature falls below preset limit.
Interlockings: The temperature measuring can be excluded via the menu "Function selection".
Other: If the temperature falls below +1°C, the sensor is regarded as faulty. It is indicated by the alarm "Int. fault".

HIGHTEMP, rect

Function: Monitoring of the internal rectifier temperature (only PCR3).

Alarm cond: The temperature in some of the internal heatsinks exceeds +80°C.
Interlockings: -
Cause:
1) The vent holes are blocked.
2) The filter on the rectifier cooling fans are clogged. Call for qualified service personnel.
3) Some of the rectifier cooling fans are faulty. Call for qualified service personnel.

Other: If the temperature falls below +1°C or exceeds +150°C, the sensor is regarded as faulty. It is indicated by the alarm "Int. fault".
During temperatures exceeding +80°C, a reduction of the current limit will be done to prevent the rectifier from being destroyed due to overheated components.

EARTH FAULT +

Function: Monitoring of the earth fault resistance.
Alarm cond: Earth fault resistance to the plus-branch falls below preset limit.
Interlockings:
1) The earth fault measuring can be excluded via the menu "Function selection".
2) In systems with parallel operating rectifiers, i.e. the number of rectifiers in the menu "Basic data" is at least 2, an interlocking is done according to the following condition: If the rectifier address is greater than 1 at the same time as the digital input for parallel operation is open. In this state, only rectifier No. 1 will be permitted to measure earth fault resistance.

Other: The limit may be set within the interval 10kΩ to 2.5MΩ.

EARTH FAULT -

Function: Monitoring of the earth fault resistance.
Alarm cond: Earth fault resistance to the minus-branch falls below preset limit.
Interlockings: See "Earth fault +".
Other: See "Earth fault +".

FUSE FAULT

Function: Monitoring of the distribution fuses.
Alarm cond: Digital input for fuse fault is in open state.
Interlockings: -
Other: Normally, the led-lamp by the panel block diagram symbol for distribution fuse will be lit in alarm state. If you wish to use this alarm for another purpose, you can via the menu "Function selection" exclude the effect on this led-lamp, i.e. it will permanently be turned off.

EQ. BLOCKED

Function: A warning for a not permitted request for equalizing charging.
Alarm cond: Equalizing charging is requested or is in progress at the same time as the digital input for blocking of equalizing charging is in open state.
Interlockings: Digital input for blocking of equalizing charging is in closed state (i.e. equalizing charging is permitted).
Other: The alarm itself is activated as usual where, among other things, the alarm delay is included. The raising of voltage that the equalizing charging normally implies is however always blocked without any delay as long as the digital input for blocking of equalizing charging is in open state.

SWITCHED OFF

Function: Informs that the rectifier is switched off.
Alarm cond: The mains switch in off position or digital input for external blocking in open state.
Interlockings: -
Other: The two led-lamps at the panel block drawing symbols for mains voltage and rectifier are turned off while the rectifier is switched off.

INT. FAULT

Function: Monitoring of the internal functions of the rectifier.

Interlockings: -
Other: The alarm text is followed by an error code consisting of two (XX) or four (YYXX) digits. The digits corresponding to XX states the error type while YY is an additional information that is special for each error type.. Every error type has its own alarm condition. Most of the internal errors calls for action taken by qualified and even authorized service personnel.

ERRORTYPE 01
Alarm cond: Error in the internal I2C-communication.
Cause:
1) Temporary interference. Acknowledge the alarm and go on as before.
2) Internal circuit fault. Call for authorized service personnel.
Other: The additional information YY (see above) states the current I2C-address in hexadecimal notation.

ERRORTYPE 02
Alarm cond: Not used.

ERRORTYPE 03
Alarm cond: The battery temperature falls below +1°C.
Cause:
1) This is the actual temperature, i.e. the rectifier is O.K. Take measures against the low temperature.
2) Shortcircuit in connections or cables to the external temperature sensor.
3) Shortcircuit in the temperature sensor.
4) Internal circuit fault. Call for authorized service personnel.

ERRORTYPE 04
Alarm cond: The battery temperature exceeds +49°C.
Cause:
1) This is the actual temperature, i.e. the rectifier is O.K. Take measures against the high temperature.
2) Interruption in connections or cables to the external temperature sensor.
3) Interruption in the temperature sensor.
4) Internal circuit fault. Call for authorized service personnel.

ERRORTYPE 05
Alarm cond: Internal reference voltage exceeds permitted range (0.5%).
Cause:
1) The alarm delay time setting is to short. Deviations of short duration may occur without being regarded as an error. Choose a delay time of at least a couple of seconds.
2) Extremely high or low temperature in the rectifier.
3) Internal circuit fault. Call for authorized service personnel.

ERRORTYPE 06
Alarm cond: The internal temperature of the rectifier falls below +1°C.
Cause:
1) This is the actual temperature, i.e. the rectifier is O.K. Take measures against the low temperature.
2) Internal circuit fault. Call for authorized service personnel.

ERRORTYPE 07
Alarm cond: The result of the internal rectifier temperature measurement exceeds +150°C.
Cause: Internal circuit fault. Call for authorized service personnel.

COMM.FAULT
Function: Monitoring of KraftNet communication to other rectifiers or units.
Alarm cond: After 10 message transmission attempts, there still are not any accepted answer.
Interlockings: -
Cause:
1) Connection or cable fault.
2) Internal circuit fault in either transmitting or receiving unit.

3) Incorrect settings in parameters regarding KraftNet communication.

Other: Along with the error message, a digit is shown that tells the actual receiving address. Master rectifiers in the system has address 0. Slaves has address 1 - 7. In double systems the address range for system number 2 starts on 10, i e the master in system 2 has got the address 10 while the slaves in system 2 has address 11 up to 17. The slave number (1 - 7) then corresponds to the units digit of the address.

SLAVE ALARM

Function: The master unit in a system of parallel operating rectifiers is supervising the alarm status of the slaves.

Alarm cond: Some slave unit has some alarm relay activated.

Interlockings: -

Other: The alarm is needed in the master unit because the presentation tools of the slaves are often hidden behind doors or something similar.

Alarm settings for charging rectifier type PCR

Alarm	Fault indications in the panel block diagram					Normal alarm settings															Your own alarm setting							
						Alarm relays				Alarm delay	Method of acknow-ledging		Alarm level										Alarm relay				Alarm delay	Method of acknow-ledging		Alarm level
													Nominal system voltage (number of cells)							Unit	Corre-sponds to								
	mains ①	rect ①	batt	distr	earth	A	B	C	D	0.1s - 63h	Aut	Ack	24V (12)	48V (24)	110V (54)	125V (60)	220V (108)	440V (208)	500V (252)			A	B	C	D	0.1s - 63h	Aut	Ack	
Overvoltage, U>		X						X		10s	X		0.15	0.29	0.65	0.72	1.3	2.5	3.03	dV	0.012V/c							dV
Overvoltage, U>>		X				X				10s	X		28.2	56.4	126.9	141	253.8	488.8	592.2	V	2.35V/c							V
Undervoltage, U<		X						X		10s	X		0.15	0.29	0.65	0.72	1.3	2.5	3.03	dV	0.012V/c							dV
Undervoltage, U<<			X			X				10s	X		21.6	43.2	97.2	108	194.4	374.4	453.6	V	1.8V/c							V
Ovp tripped		X				X				1s		X	28.8	57.6	129.6	144	259.2	499.2	604.8	V	2.4V/c							V
Battery fault			X					X		10m	X		0.5	0.5	0.5	0.5	0.5	0.5	0.5	%	0.012V/c							%
Mains fault	X						X			1s	X		-	-	-	-	-	-	-	-	-							-
Rectifier fault		X					X			1s	X		25.8	51.6	116.1	129	232.2	447.2	541.8	V	2.15V/c							V
Battery circuit fault			X					X		0.1s		XX	23.52	47.04	105.8	117.6	211.7	407.7	493.9	V	1.96V/c						XX	V
Measuring circ. fault		X						X		1s	X		10	10	10	10	10	10	10	%	-							%
High current, I> ③										10s	X		-	-	-	-	-	-	-	-	-							-
Overload ④								X		24h		X	-	-	-	-	-	-	-	-	-							-
No loadshare ④		X						X		10m	X		15	15	15	15	15	15	15	$\%I_{rated}$	-							%
High temp, battery			X					X		30m	X		30	30	30	30	30	30	30	°C	-							°C
Low temp, battery			X					X		30m	X		15	15	15	15	15	15	15	°C	-							°C
High temp, rectifier		X					X			60s		X	-	-	-	-	-	-	-	-	-							-
Earth fault +					X				X	1s	X		100	100	100	100	100	100	100	kΩ	-							kΩ
Earth fault -					X				X	1s	X		100	100	100	100	100	100	100	kΩ	-							kΩ
Fuse fault				X				X		0.1s	X		-	-	-	-	-	-	-	-	-							-
Blocked eq.charging										30s	X		-	-	-	-	-	-	-	-	-							-
Switched off	②	②								1s	X		-	-	-	-	-	-	-	-	-							-
Internal fault		X					X			10s		XX	-	-	-	-	-	-	-	-	-						XX	-
Communicat. fault		X					X			60s	X		-	-	-	-	-	-	-	-	-							-
Slave alarm						⑤	-	-	-	0.1s	X		-	-	-	-	-	-	-	-	-	-	-	-	-				-

XX: Do not change this setting. The alarm condition is volatile. The acknowledge demand is therefore necessary in order to catch the alarm.

①: Green light during normal state, red during alarm. Other led-lamps is off during normal state, red during alarm.

②: Led-lamp is turned off.

③: Showed only on display, i.e. no led-lamp indication.

④: The alarm does not show at all during the delay time.

⑤: Has no own alarm relay function.

Appendix B
OTHER SETTINGS

Other settings for charging rectifier type PCR

Parameter	Normal settings							Unit	Corresponds to	Your own setting
	Nominal system voltage (number of cells)									
	24V (12)	48V (24)	110V (54)	125V (60)	220V (108)	440V (208)	500V (252)			
Float charging voltage, Ufloat	26.76	53.52	120.4	133.8	240.8	463.8	562	V	2.23V/c	V
Equalizing charging voltage, Ueq	27.72	55.44	124.7	138.6	249.5	480.5	582.1	V	2.31V/c	V
Current limit, Ilimit	100							%		%
Overvoltage protection, OVP	Yes									
Earth fault measuring, Rearth	Yes									
Mid-voltage measuring, Umid	No									
Mid-voltage meas, measuring point	50							%		%
Temperature measuring, Temp	No									
Battery circuit test, Bctest	Yes									
Battery circuit test, test interval	24							h		h
Rectifier test, test length	30							s		s
Rectifier test, test interval	30							m		m
Test level, Usink	-15							%		%
RI compensation	0.0							%		%
Distrib. fuse fault indication, F-led	Yes									
Slave under KM	No									
Language	S									
Rated voltage, Urated	24	48	110	125	220	440	500	V		V
Rated current, Irated	Depends on rectifier model							A		A
Minimum charging voltage, Umin	21.6	43.2	99	112.5	198	396	450	V	Urated-10%	V
Temperature regulation, dU1	0							mV/°C		mV/°C
Temperature regulation, dU2	0							mV/°C		mV/°C
Temperature regulation, Ut-min	21.6	43.2	97.2	108	194.4	374.4	453.6	V	1.8V/c	V
Temperature regulation, Ut-max	30	60	135	150	270	520	614.4	V	2.5V/c	V
Number of rectifiers, #rects	1									
Rectifier address, R-addr	master 0									
Number of systems	1									

Appendix C
ADDITIONS AND CHANGES