CONTROL MODULE

General index

1. Definition of Control Module and interaction with the different parts of the system.

1.1. Basic description.

The Control Module manages the operating of the system completely, saves all the parameters and calibrations, as well as the management of the input, output and battery data.

By means of its RS485 port, it has communication with all the rectifier modules of the system, by getting the complete particular information of each module in order to act according to the received data. Therefore, it can take all the suitable decisions in real time at each different condition, in order to set the output voltage that they have to supply, limits and current sharing, battery charging current, etc.

Regarding batteries, its functionality has to be considered as an essential element of vital importance and costly, which in any system has to guarantee a permanent and uninterruptible power supply to the loads during the blackouts or mains faults. Any management of them is done by the Control Module. It checks that the charging current is the most suitable at every moment to keep the batteries at their optimal level, without affecting to their useful life, a part from their intrinsic degradation in the time. A high and continuous overcharge damages the batteries irreversibly, but, in case of deficient charge, they will not meet their purpose.

This Control Module allows managing the charging currents of two battery strings, so each string charge will be controlled separately.

The Control Module is able to manage up to 30 rectifier modules, regardless of the operating mode, in parallel or redundant (N+1, N+2... N+N). Loads connected to the system are shared among all rectifier modules, thanks to its parallel connection. The difference among the output currents supplied by each rectifier module is lower than ±1%.

Among other quality performances, it manages the low voltage contactor (LVD) and a second one for noncritical loads, both are optional, which can be standard type or magnetic locking. The back up time is increased for those critical loads, when the contactor of the noncritical loads is disconnected during the mains failure periods. The manage over the contactors is done through the data got in real time.

The low voltage contactor (LCD) disconnects physically the batteries from output when the voltage level is below the preset limits.

1.1.1. Settings.

Control Module is supplied inside a metallic case of 2U height and separate from the DC Power S equipment, as a hot swap sub-element.

The front side of the Control Module, through which the user is able to interact, is a silk-screened polycarbonate in RAL9005 colour and where the following parts are located, with their respective functions:

- Backlight LCD panel of 4x40 characters and contrast setting. In it, the following menus and submenus can be displayed:
  - ❒ Measurements
  - ❒ Alarms.
  - ❒ Data logger.
  - ❒ Events.
  - ❒ Advanced battery management.
  - ❒ Information of modules.
  - ❒ Parameters of the system.
- Keypad with six membrane buttons. By means of them, we can browse through the menus shown in the LCD panel to consult all the information got by the unit, as well as to do settings and calibrations in an easy and friendly way.
  - ❒ Four buttons for browsing or positioning **(◄)**, **(►)**, **(▲)** and **(▼)**. They allow moving the cursor through the different writing fields, and also it allows browsing through the different menus.
  - ❒ One button to select or validate **(ENT)**.
  - ❒ One button to exit or escape **(ESC)**. It is used to both escape from field without accepting the change and go back to main Screen from any place of the menu.
- Eleven LED indicators of the system (status of the equipment, alarms, communications and activated relays). Each one of them light with the activation of their corresponding function:
  - ❒ Status of the equipment (green).
    - – Control Module fed.
  - ❒ Relays (reds).
    - – Three of alarm (1-2-3-), corresponding to the dry contacts: (A1 -Urgent alarm-), (A2 -Nonurgent alarm-), (O1 -Observation alarm-). In the manual of the equipment is preset the grouped alarms to each dry contact.
    - – Two useless indicators (4-5).
  - ❒ Alarm (red).
    - – One for general alarm. It lights when the alarm of the equipment is triggered.
  - ❒ Communication (yellows).
    - – Four indicators as regards to two communication ports and their respective indications of transmission (TX) and reception (RX). One of internal order (INT) and another one for external order, corresponding to COM2 port of communication module, one RS232 supplied in DB9 connector.
- Finally, a connector with exclusive use for the S.T.S..

1.1.2. Alarms.

In case any alarm is active, it will be shown in the LCD panel in a blinking way till it has been acknowledged by the end-user or till it has been cancelled.

There is an alarm menu to check the current active alarms.

The alarms that can be displayed are:

- Discharging battery.
- Low battery voltage.
- End of back up time.
- Overload of the system.
- Overtemperature of the battery.
- Safe overload (nominal current less 10%).
- Overload of use (end-user value setting).
- High battery voltage.
- Low AC input voltage.
- Digital input 1.
- Urgent alarm coming from rectifier modules (It is active when there is more than one module with alarm/s).
- Nonurgent alarm coming from rectifier modules (It is active when there is only one module with alarm/s).
- High battery charging current.
- High input voltage.
- Low output voltage.
- High output voltage.
- Digital input 2.
- Noncritical loads disconnected.
- Isolation fault +.
- Communication fault between the Control Module and rectifier modules.
- Low electrolyte level.
- Digital input 3.
- Digital input 4.
- Digital input 1.
- Isolation fault –.

Any alarm is logged in two different data loggers, one as general use for the system and another one for rectifier modules.

Any event of any data logger can be shown through the LCD panel of Control Module. And for each event of any data logger is shown together with the following information:

- Date and time of triggering
- Date and time of acknowledging
- Date and time of deactivation or cancellation.
- Status of the equipment with voltages, currents and temperatures when the alarm was triggered.

Data logger behaviour is FIFO (First In First Out), in case all the events or logs were occupied.

For maintenance purposes, the dry contacts alarms and communication ports will be deactivated, in order to avoid misunderstandings of the alarms by the end-user. Nevertheless, the alarms are still shown in the LCD panel. This status of alarm deactivation is cancelled automatically after one hour (this value can be set by the technician from S.T.S., at site).

1.2. Rectifier modules.

They are the ones in charge of supplying DC and controlled energy from AC mains, either single phase or three phase, although all the modules are single phase. Each Control Module is able to manage up to 30 rectifier modules, of equal power, which is between 1000 W and 2700 W, being able to manufacture tailor made equipments according to the end-user's needs.

All rectifiers have a microprocessor, where several parameters are assigned automatically, by the mere fact of connecting it to the cabinet, which has to include a Control Module. The Control Module makes periodical modules searching, so after connecting the module to the system and wait several seconds, it sets automatically the module in a safe and controlled way to the system. Plug in a rectifier module can be done with the equipment shutdown or hot, because its parameter assignment will be done automatically in the next seconds after its supply.

1.2.1. Cycling function and economy mode.

Usually the sizing of the equipment is based on the estimated power for the loads plus the battery charging current and finally the redundant modules that the system needs (N+1, N+2... N+N) are added. But in almost all the cases, as the rectifier modules are connected in parallel and load sharing, all of them works at half power, so it means having a low efficiency, power factor, and THDI, which are not recommended.

To solve this phenomena, the Control Module has the economy mode (Smart mode). This operating mode is based on shutting down the redundant modules and any of them that are not needed in order to get the correct quantity of rectifiers that work at 80% of their capacity (this figure can be set through the LCD panel). In case of failure of any of them, the Control Module will start up one of the shutdown rectifiers, in order to replace the damaged module. Therefore, it is achieved an optimal efficiency, power factor and THDi.

Also, to age all the parts or elements in the same way when the economy mode is activated, the cycling function is available. This function swap the shutdown modules with the ones started up, so they are aged in the same way. The cycling period is every 10 hours, but the customer can set this value to the required one.

1.3. Batteries (Maintenance free, NiCd or wet).

The rectifier system usually has a battery set, to store the energy during the normal operating and use it during the blackouts. Therefore the critical loads will be in operation during the stated time. At the same time the batteries are protected against deep discharges thanks to the low voltage contactor (option).

This rectifier system with Control Module can manage sealed AGM maintenance free, NiCd or wet batteries.

The design life of the batteries is according to the needs of the end-user.

The cells or blocks are integrated in the cabinet, over fix or mobile shelves, in order to make easy its replacement or electrolyte fill-in (NiCd or wet batteries only).

Polarity of each cell or block is marked in a permanent way over the battery. And each one has a nameplate with its own main specifications.

Each battery string is protected in its positive or negative pole in those equipments referred to earth or in both poles if the output is floating, ready to support the service conditions of the end-user.

During the back up time period, the output voltage is inside the stated limits in the DC POWER S rectifier modules section.

Meanwhile the rectifier system is working in normal mode, each battery string is connected to the DC bus and at the same time in parallel with the loads to supply. Batteries are charged in accordance with the modes stated in section 1.3.1 when it is needed.

1.3.1. Battery management.

The system can charge the batteries between 0,1 and 0,99C, depending on the requirements of the end-user till the floating voltage. Usually the current destined to charge the batteries is usually set between 0,1 and 0,3C, and the rest is used to supply the own loads of the end-user. Nevertheless and although it is not usual, the Control Module can manage higher currents to charge the batteries.

Battery floating voltage is compensated by the ambient temperature of themselves, in order to extend their lifetime. Also it is possible to fix the threshold of maximum and minimum temperature where the compensation will act, so out of this range, the compensation will only be done inside the preset limits.

A part from the temperature limits, the maximum voltage parameter can be also restricted in order to protect the batteries against over voltages, which on the other side are not good , because they are harmful for the battery lifetime.

Thanks to its powerful microprocessor, there are three different recharging modes:

- Boost.
  - ❒ Automatic.
  - ❒ Manual.
- Periodical.
- Exceptional or manual.

They allow the Control Module to charge any type of batteries: NiCd, wet and maintenance free AGM.

1.3.1.1. Automatic and manual boost charge.

In case of an electrical mains fault, a energy counter calculates the energy subtracted from batteries when batteries meet the discharge conditions and the voltage is below Un +2,5%. Once the electrical mains is restored, a charge is done with a duration equivalent to one or some of the following parameters:

- Charge factor:

  This factor is stated by the battery manufacturer. And it is equivalent to the energy that has to be recharged after a battery discharging.
- Minimum charging current:

  When the charging current is lower than the minimum charging current, this mode is shutdown. The Control Module waits 4 minutes before stopping the charge in order to check that the current value is lower than the fixed in such parameter.
- Minimum charging time:

  It is the minimum time destined for charging mode.

  The Control Module allows fixing the maximum charging time of this mode, and in case of exceeding it, this charging mode will be stopped without taking care of voltage and current, in this moment.

  This charge mode can be done manually or automatically. In case of manual activation, the above indications will be followed.

1.3.1.2. Periodical charge.

The periodical charge does a boost charge but repetitive in time. This type of charge allows setting the maximum voltage, maximum recharging time and periodicity.

The periodical charge is only done when the system has not done any charge during the preset period. If the periodical charge can't be done, due to a blackout, it will be logged as a pending job and it will be done as soon as the electrical mains is restored.

The next set date of the periodic charge will be shown in the LCD panel and it will be done at 12 h (AM) of the set date.

1.3.1.3. Exceptional or manual charge.

The Control Module allows doing a manual charge, where the following parameters can be set as:

- Maximum voltage (the maximum voltage that can be set is 15 V DC for each battery block of 12 V DC).
- Recharging time.

The manual charge is only done when the alarm of «Output protection tripped» is triggered. If the manual charge couldn't be done due to a blackout, it is logged as a pending job, and it will be done as soon as the electrical mains is restored.

This charging mode can only be activated manually.

1.4. Communication modules.

There is a communication module described in the own user's manual of the equipment. Although this complete communication module is not standard, the availability of the ports is the following:

- Dry contacts.
- RS232 or RS485.
- TCP/IP.

1.4.1. Dry contacts.

There are three independent dry contacts alarms. These dry contacts are set as:

- Urgent alarm (A1).
- Nonurgent alarm (A2).
- Observation alarm (O1).

Maximum power of the contacts is 6A 250Vac.

Any alarm in point 1.2.2 can be set to any dry contact, so the end-user can decide the alarms that are urgent, nonurgents and observation. Nevertheless in the user's manual of the equipment is defined the group of alarms set to each relay.

Each dry contact has two contacts: normally open (NO) and closed (NC).

As soon as any dry contact is activated, it is shown in the synoptic with an LED indicator.

1.4.2. Communication ports.

The Control Module has a RS232 or RS485 ports (mutually exclusive)and TCP/IP. The connector is DB9 and RJ45 type re-

spectively. They can be used at the same time with no restriction. Nevertheless, there are two RS232 physically:

- First RS232 is associated to COM1, which will be disabled in case of installing the telemaintenance SICRES card into the corresponding slot. The own SICRES card has a DB9 for the RS232 port.
- The second RS232 port is associated to COM2 channel.
  - ❒ Baud rate is selectable among: 1200, 2400, 4800, 9600, 14400, 19200, 38400, 57600 and 115000 bauds.
  - ❒ MODBUS protocol.
- The RS485 is associated to COM3 channel. The signals of the port in the three pin connector are the following from left (pin 1), to right (pin 3): +, – and GND.
  - ❒ Selectable baud rate among: 1200, 2400, 4800, 9600, 14400, 19200, 38400, 57600 and 115000 bauds.
  - ❒ MODBUS protocol.

The RS232 from COM2 channel and the RS485 of COM3 channel are mutually exclusive in use, being not possible to use them at the same time.

- TCP/IP (by means of the telemaintenance SICRES card, option):
  - ❒ Selectable baud rate among: 1200, 2400, 4800, 9600, 14400, 19200, 38400, 57600 and 115000 bauds.
  - ❒ MODBUS TCP protocol.

1.4.2.1. Extended digital inputs and dry output contacts.

The digital inputs and dry output contacts module is in charge of extend the quantity of dry contacts of the system. Such outputs can be set to any alarm of the system, likewise it allows the input signals of the electrolyte level and temperature probe.

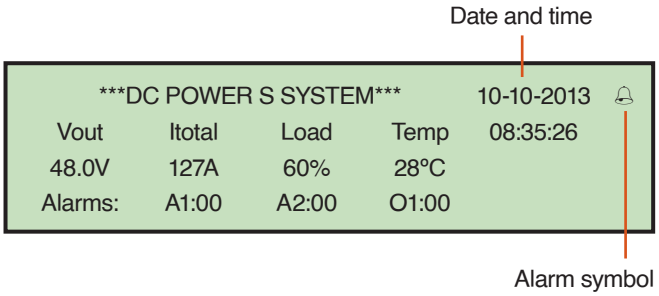
The extension to 9 dry contacts have a maximum voltage and current of 250 V AC and 6 A respectively. Each individual connector has a normally open (NO) and normally closed (NC) dry contact.

The setting of each dry contact is done by means of the Control Module.

2. Interpretation of the initial screen of the Control Module.

2.1. Main screen (Screen 0.0).

It is the screen that it is displayed when the system is connected and it is the one that returns to, after a period time of inactivity inside any menu.

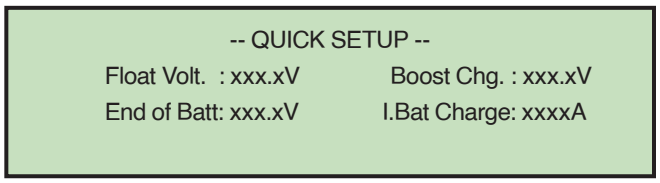


Screen 0.0.

The screen 0.0 shows several measurements that are collected by the system. They are the following:

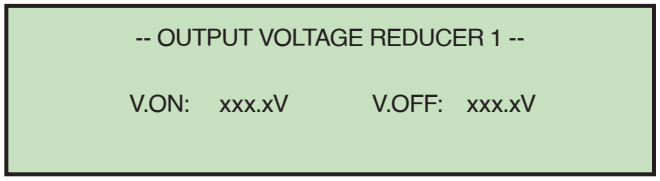
- **Vout**: Output voltage of the system with one tenth.
- **Itotal**: Total current of the system.
- **Load**: Percentage of the total load connected to the system, if there were cabinets in parallel it would be the sum of all of them.
- **Temp**: Temperature taken by the sensor connected to the Control Module.
- **Alarms A1**: Number of active «urgent» alarms in the system.
- **Alarms A2**: Number of active «non-urgent» alarms in the system.
- **Alarms O1**: Number of active «observation» alarms in the system.
- **Alarm symbol**: The alarm icon is only showed in case there is one or more active alarms.

2.2. Quick Setup.

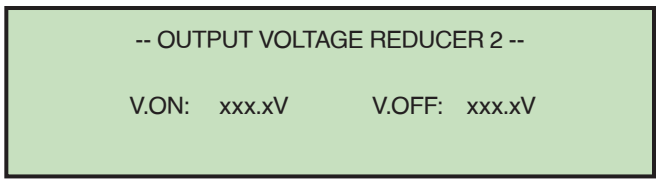


Screen 0.1

Screen 0.1 allows you to adjust the Float Voltage, Fast Charge Voltage, End of Cut-off Voltage and Battery Charge Intensity.



Screen 0.2



Screen 0.3

Screens 0.2 and 0.3 allow you to set the activation (V.ON) and deactivation (V.OFF) voltages of voltage reducers 1 and 2.

3. Input measurements.

This group of screens shows all the measurements referred to the input of the system.

3.1. Input measurements of the System.

Voltage	Current	Freq.
R-S = 380 V	R = 015 A	50 Hz
S-T = 380 V	S = 015 A	
T-R = 380 V	T = 015 A	

Screen 1.1

The measurements are:

- **Voltage R-S**: Alternating voltage in root mean square value between the phase R and S in case it is a three phase input system.
- **Voltage S-T**: Alternating voltage in root mean square value between the phase S and T in case it is a three phase input system.
- **Voltage R-T**: Alternating voltage in root mean square value between the phase R and T in case it is a three phase input system.
- **Current of the phase R**: Alternating current in root mean square value of the phase R.
- **Current of the phase S**: Alternating current in root mean square value of the phase S.
- **Current of the phase T**: Alternating current in root mean square value of the phase T.
- **Freq.**: Input frequency of the mains in Hertz (Hz).

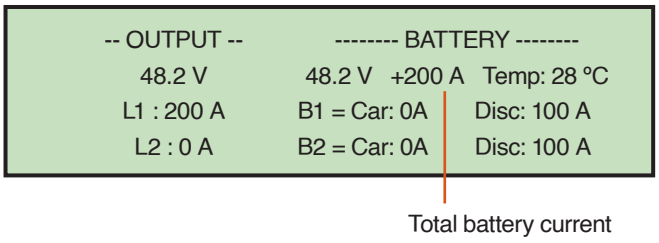
4. Output measurements.

This group of screens displays all the measurements related with the output, so it is the DC voltage that feeds the loads.

4.1. Output measurements of the system.

This screen is always visible, because the measurements are done by Control Module.

As output measurements are considered, everything referred to the rectifier supply and batteries too, because they provide the energy in case of mains failure.



Screen 2.1

The only part referred to the output, has the following measurements:

- **Output voltag**e: It is the output voltage of the system.
- **Current L1**: Current measured by the Control Module referred to the output current of that cabinet.
- **Current L2**: The Control Module is ready to control and measure the current of an extra output current. L1 is the main one, and L2 is the secondary current.

Next there are the measurements referred to the batteries. The Control Module can manage up to 2 battery strings by itself.

The measurements in appearance order are:

- **Battery voltage**: It is the battery voltage with one tenth.
- **Total battery current**: It is the sum of the currents that the battery provides, it has sign therefore if it is negative it will be the discharge current, and if it is positive it will be the charge current. This current is the sum of all the currents measured by the Control Module. The sum of the currents follows the formula:
- **Temp**: It is the temperature measured by the Control Module, normally it will the one in the batteries.
- **Current B1 Car.**: It is the charge current of the string number 1 measured by the Control Module.
- **Current B1 Disc.**: It is the discharge current of the string number 1 measured by the Control Module.
- **Current B2 Car.**: It is the charge current of the string number 2 measured by the Control Module.
- **Current B2 Disc.**: It is the discharge current of the string number 2 measured by the Control Module.

5. Consultation of the alarms of the system.

The next group of screens shows the active alarms of the system. When any of these alarms are activated, the message is displayed in blinking mode until it is acknowledged, either manually by pressing the key **(ENT)**, or through the communications. Once it is acknowledged it doesn't blink but it is still active. If you want to know the current active alarms of the system, consult the group of screens 3.0. The screens of alarms follow the following format:

Screen 3.17

Every alarm makes an event input in the data logger of the system, being recorded the time when it started, followed by several data related with the moment when the alarm occurred.

Next, it is deeply explained the circumstances that provoke any alarm situation.

5.1. Battery discharging.

This alarm is displayed when the Control Module detects a battery discharge current measurement. It is deactivated as soon as the battery discharge current is 0.

5.2. Alarm battery low.

This alarm is activated when the battery voltage measured by the Control Module is lower than the minimum battery voltage preset in the system. It is deactivated when the voltage overcomes that value.

5.3. End of battery.

This alarm is activated when the output voltage measured by the Control Module is lower than the end of autonomy voltage preset in the system, also this alarm controls the end of autonomy contactors fitted in the equipment and open them in order to protect the batteries from deep discharges that could make their expected lifetime shorter. It is deactivated as soon as the output voltage of the system is higher than the preset end of autonomy voltage and the alarm mains failure is not present.

5.4. Maximum system current exceeded.

The overload alarm in the system is activated when the total output current overcomes the maximum current of the system and it is deactivated when the output current of the system is below of the preset value fixed as alarm. The total output current of the system is the sum of the measurements of L1 and L2 of the Control Module. This value is dynamic and it depends on the quantity of installed modules. It can't be changed by the user.

5.5. Battery overtemperature.

The battery overtemperature alarm is activated when the temperature measured by the Control Module overcomes the maximum preset temperature. It is deactivated when the temperature measured by the Control Module is lower than the preset alarm.

5.6. Secure maximum current exceeded.

The alarm overload of safety is activated when the total output current overcomes the maximum current of the system minus 10%. It is deactivated when the output current of the system is below this value. The total output current of the system is the sum of the currents measured by the Control Module. This value is dynamic and it depends on the quantity of installed modules. It can't be changed by the user.

5.7. Utility maximum current exceeded.

By default, the alarm overload of utility is activated when the total output current overcomes the maximum current of the system minus 10%. It is deactivated when the output current of the system is below this value. The total output current of the system is the sum of the currents measured by the Control Module. This level can be changed by the user.

5.8. Battery voltage high.

This alarm is activated when the battery voltage overcomes the maximum battery voltage preset in the system. It is deactivated when the battery voltage is lower than the value preset as maximum (See alarm settings).

5.9. Input voltage low.

The low input voltage alarm goes together with the mains fault. This alarm is activated when the measured input voltage is lower than the minimum preset value. It is deactivated when the input voltage overcomes the minimum preset value.

5.10. Output protection open.

The Control Module detect the protection tripping in a generic mode, because it only has one digital input.

5.11. Urgent alarm modules.

It is activated when there is more than one rectifier module with any alarm. And it is deactivated when there is not more than one rectifier module with alarm.

5.12. Non-urgent alarm modules.

It is activated when there is only one rectifier module with alarm, although such module has more than one, meanwhile they belong to the same module. It is deactivated when there is not any module with alarm or when there are more than one module with alarm, because then the urgent alarm of modules is activated and the non-urgent one is deactivated.

5.13. Battery charge current too high.

It is activated when the total battery charge current of the system, which is the one measured by the Control Module overcomes the maximum preset value. It is deactivated when it doesn't overcome the preset value.

5.14. Input voltage too high.

It is activated when the input voltage measured by the system overcomes the maximum preset input voltage. And it is deactivated when the input voltage is below the maximum preset input voltage.

5.15. Output voltage low.

It is activated when the Control Module detects an output voltage lower than the minimum preset value in the system. It is deactivated when the measurement overcomes the minimum preset output voltage.

5.16. Output voltage too high.

It is activated when the Control Module detects an output voltage higher than the maximum preset value in the system. It is deactivated when the measurement is below the maximum preset output voltage.

5.17. Battery protection open.

It is activated when the Control Module detect any of the battery protections tripped. It is deactivated when there is not any battery protection tripped.

5.18. Automatic disconnection of low-priority load.

It is activated when the battery voltage measured by the Control Module is below of the preset disconnection voltage of the non--critical loads. And it is deactivated when the measurement overcomes the preset voltage and the mains fault alarm is not present. This alarm opens the contactor in a certain moment. After a mains fault, in the outgoing distributions there are loads that the end user wants to keep them ON longer time than other ones that are less important. Then the system allows to set the shutdown voltage for the low-priority loads. At this voltage the system will disconnect the contactor in order to extend the autonomy for the critical loads to the maximum.

5.19. Communication fault with one or more rectifier modules.

It is activated when the communication with any rectifier module is lost. In this alarm screen it is displayed the address of the module with the communication fault. It is deactivated once the alarm is acknowledged, either through the keypad or through the communications, or if the communication with that module is restored.

5.20. Low battery electrolyte level.

The alarm is triggered when the electrolyte level of the battery, where the probe is installed, is below the ideal preset level.

Keep in mind that the level test is done in only one battery and it is admitted the result as generic for the rest. Although it is not usual but it is possible, an exceptional situation can occur, the electrolyte level in any other battery can be below the limit, meanwhile the one with the probe, the level is correct.

5.21. Isolation fault +.

The alarm is triggered when the earth leakage current of the batteries to positive pole exceeds the preset value assigned in the Control Module.

5.22. Isolation fault –.

The alarm is triggered when the earth leakage current of the batteries to negative pole exceeds the preset value assigned in the Control Module.

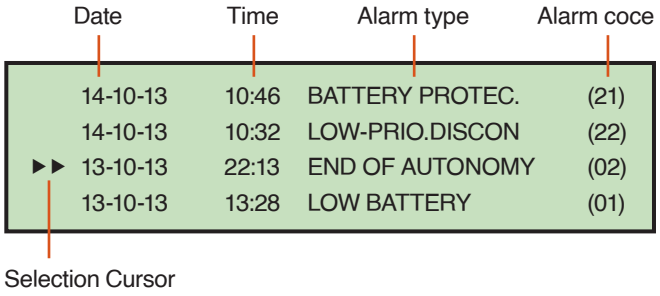
6. Data logger of the system.

In this group of screens is recorded all the events of the system, in permanent way inside a NVRAM, so they are not cleared if it is not done directly by the end-user.

The end-user can consult the events or logs that has happened, in an easy and detailed way, as it is described in section 6.1. The behaviour of the data loggers is FIFO (First In First Out), in case all the logs were occupied.

6.1. Event list.

This screen displays the occurred events in a scroll way, like a list, where the first element of the list is the last occurred event in time. As it is showed in the following figure of the screen 4.2.



Screen 4.2

As it has been showed, there is a list with the events ordered depending on the activation time, from the most recent one to the oldest one. The browsing through the list is done with the up **(▲)** and down **(▼)** scroll keys, which moves the cursor in order to select a concrete event. In case there is not any event, the system displays a text message showing that it is «empty».

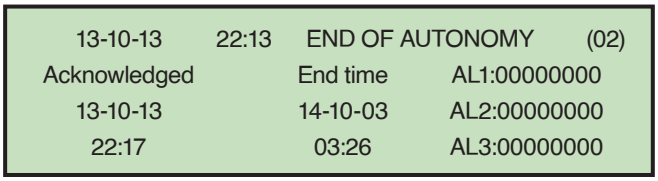
In this screen there are five fields of information:

- **Selection cursor**: It allows to display all the events by using the up **(▲)** and down **(▼)** scroll keys.
- **Date**: It means the date when the event occurred.
- **Time**: It means the time when the event occurred.
- **Alarm type**: It means the type of the recorded alarm by using several words as a code.
- **Alarm code**: It means the type of recorded alarm by using the code of that alarm. In the next section there is a list with all the available alarm codes.

Using the cursor, the event is selected and with the right scroll key **(►)** we have access to the details of the selected event.

6.2. Event details (1).

This screen displays several data related with the selected event in order to provide the status of some variables when the alarm occurred .



Screen 4.3

As it is showed, the selected event, in the above screen, is displayed in the first row. Next we have the following information, which is divided into three groups:

- **Acknowledged**: This column informs about the date and time when the alarm has been acknowledged, either through the keypad or through the communications. In case it is not acknowledged yet, all the characters are zeros.
- **End time**: This column informs about the date and time when the alarm has finished. In case it is not finished yet, all the characters are zeros.
- **Alarm**: It is showed the status of the three data loggers when the alarm was activated. Each character is one alarm. The character «0» means that the alarm is not activated, meanwhile the character «1» means activated. The alarms go from left to right.

  AL1:
  - ❒ Alarm 1: Discharging battery (00).
  - ❒ Alarm 2: Low battery (01).
  - ❒ Alarm 3: End of autonomy (02).
  - ❒ Alarm 4: SYSTEM current exceeded(03).
  - ❒ Alarm 5: Battery overtemperature (04).
  - ❒ Alarm 6: SECURE current exceeded (05).
  - ❒ Alarm 7: UTILITY current exceeded (06).
  - ❒ Alarm 8: Remote shutdown(07).

  AL2:
  - ❒ Alarm 9: Battery voltage too high (08).
  - ❒ Alarm 10: /*RESERVED*/
  - ❒ Alarm 11: Input voltage low (Mains failure) (10).
  - ❒ Alarm 12: Digital input 1 (11).
  - ❒ Alarm 13: Module URGENT alarm (12).
  - ❒ Alarm 14: Module NON-URGENT alarm (13).
  - ❒ Alarm 15: /*RESERVED*/
  - ❒ Alarm 16: Battery charge current too high (15).

  AL3:
  - ❒ Alarm 17: Input voltage too high (16).
  - ❒ Alarm 18: /*RESERVEAD*/
  - ❒ Alarm 19: /*RESERVED*/
  - ❒ Alarm 20: Output voltage low(19).
  - ❒ Alarm 21: Output voltage too high (20).
  - ❒ Alarm 22: Digital input 2 (21).
  - ❒ Alarm 23: LOW-PRIORITY load disconnection (22).
  - ❒ Alarm 24: Isolation fault (+) (23).

If we press the right scroll key **(►)** again, we go to the second detail screen of that event.

6.3. Event details (2).

It is the continuation of the detail screen.

	Input		Output		Battery	
R-S:	0 V	0 A	Vs:	40.2 V	Vb:	40.2 V
S-T:	0 V	0 A	Is:	60 A	Tb:	30.2 °C
T-R:	0 V	0 A	Id:	60 A	Ic:	0 A

Screen 4.4

Different fields are displayed. The ones referred to the input are the followings:

- **Voltage R-S**: Root mean square value of the voltage between phase R and S when the alarm was activated.
- **Voltage S-T**: Root mean square value of the voltage between phase S and T when the alarm was activated
- **Voltage T-R**: Root mean square value of the voltage between phase T and R when the alarm was activated
- **Current R**: Root square mean value of the current of the phase R.
- **Current S**: Root square mean value of the current of the phase S.
- **Current T**: Root square mean value of the current of the phase T.

The ones referred to the output are:

- **Vs**: Output voltage when the alarm was activated.
- **Is**: Total output current of the system when the alarm was activated.

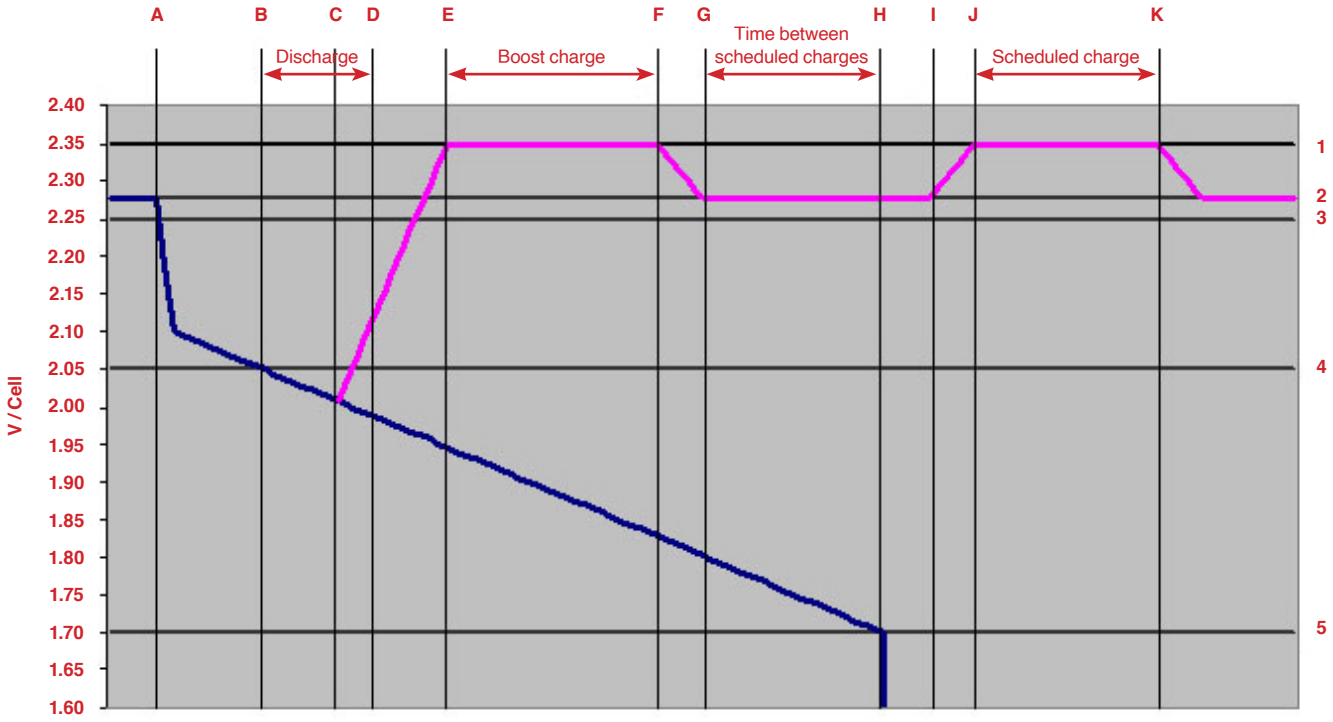
The ones referred to the batteries are:

- **Vb**: Battery voltage when the alarm was activated.
- **Tb**: Battery temperature when the alarm was activated.
- **Ic**: Total battery charging current when the alarm was activated.
- **Id**: Total battery discharging current when the alarm was activated.

7. Battery charge management.

This group of screens is the different modes to charge the batteries, and they allow to extend their design lifetime.

To modify the fields of these screens, press the key enter **(ENT)** till reaching the wanted field, once it is selected with the vertical scroll keys **(▲)** and **(▼)** modify the numeric field and with the horizontal scroll keys **(◄)** and **(►)** change the character, to validate it press the key enter **(ENT)** and the next field is activated automatically. Press escape **(ESC)** if all the fields to modify are completed or to escape.



Events (Preset values).

A.- AC mains failure.

B.- As soon as the voltage reaches –2.05V/cell, the calculation of time and discharge energy starts.

C.- AC mains is restored.

D.- When the battery current overcomes the 2A, the calculation of time and energy stop (Discharge = D-B).

E.- When the voltage overcomes the –2.25V/cell, the calculation of charging time starts (Charge = discharge x charge factor).

F.- The battery boost charge finishes.

G.- Start to count the time between scheduled charges (G-H = 30 days by default).

H.- Battery disconnection when the voltage reaches –1.7V/cell.

I.- It is needed a scheduled charge.

J.- Starts the scheduled charge.

K.- Finishes the scheduled charge.

Voltage levels (Preset values).

1.- Rectifier voltage of charging level (-2.35V/cell).

2.- Floating voltage (-2.275V/cell).

3.- Threshold charging voltage (-2.25V/cell).

4.- Threshold discharging voltage (-2.05V/cell).

5.- End of autonomy level (1.7V/cell).

7.1. Battery management - status.

This screen is only displayed when the user enters the calibration or higher password (See maintenance of the system).

BATT. CHARGE MANAGEMENT		Charge time
BOOST CHARGE :	ON(AUTO)	0012 min.
EQUALISING CHG.:	OFF	Next charge
SCHEDULEG :	OFF	22-10-13

Screen 5.1

There are three types of charge: boost, equalising and scheduled. In this screen is displayed the status of each one. Only one of them can be executed at the same time.

The possible statuses are:

- **OFF**: Shutdown status. It means that this charge is not ON.
- **ON (MAN)**: The charge type has been activated manually.
- **ON (AUTO)**: That charge shows this status when it is activated by the system automatically. The only possible action to do is to stop the charge manually.
- **ON (HOLD)**: Hold mode. It means that charge is ON, but it is waiting to do it for any reason.

On the right of this screen, it is displayed the charge time of the system as well. In the above example would be 12 minutes that the boost charge is ON.

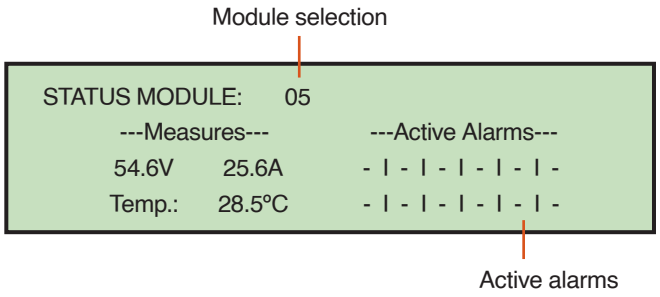
Also the date of the next scheduled charge can be displayed, being possible to change and to set it from the fixed date. If the scheduled charge is not activated, it is displayed 00-00-00. As soon as any boost, sudden or scheduled charges finish the date of the next scheduled charge is modified automatically.

8. Information of the rectifiers modules.

This group of screens shows all the information related with all the rectifier modules.

8.1. Measurements and alarms.

It is showed the measurements and alarms of the selected module.



Screen 10.1

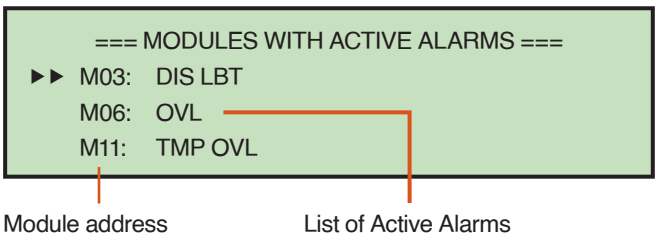
The first step to consult any measurement or alarm of any module, is to select the wanted module by pressing the key enter **(ENT)** and with the vertical scroll keys **(▲)** and **(▼)**, up or down to set the number till the wanted one is selected. Once, it is selected press enter **(ENT)** again to validate the selection.

After this, all the parameters showed in the screen belong to the selected module. The fields are:

- **Output voltage**: Output voltage of the module, in tenth of Volt.
- **Output current**: It is the current that this module is supplying, in tenth of Ampere.
- **Temp.**: It is the temperature of the heatsink of the selected module.
- **Active Alarms**: These checkboxes show the current active alarms of the selected module in a abbreviated way. The abbreviations of the alarms are the following:
  - ❒ «DIS»: Discharging batteries.
  - ❒ «LBT»: Battery low.
  - ❒ «BEA»: Battery at end of autonomy.
  - ❒ «OVL»: Overload.
  - ❒ «TBT»: Batery temperature.
  - ❒ «TMP»: Heatsink temperature.
  - ❒ «REC»: Rectifier fault.
  - ❒ «SHT»: Shutdown (Remote shutdown).
  - ❒ «OUT»: Over voltage.
  - ❒ «PFC»: PFC fault. (Power Factor Correction).
  - ❒ «INP»: Mains failure.
  - ❒ «INS»: Insulation failure.

8.2. Modules with active alarms.

This screen shows the list of alarms in the modules, by indicating what module has it and what alarm is.



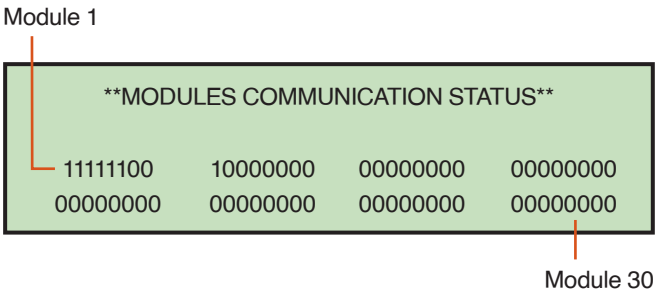
Screen 10.2

As it is showed in the above screen, it is displayed the module address with active alarm followed by the list of active alarms of it. The alarms are expressed in an abbreviated way as it has been described in the previous section.

With the vertical scroll keys **(▲)** and **(▼)** we move up and down through the list.

8.3. Status of the module communication.

This screen shows the status of the communications between the installed modules and the system continually .



Screen 10.3

Each character means each one of the modules. The first, up on the left, means the number address 1 of the modules, and the last one, down on the right, is the address number 30.

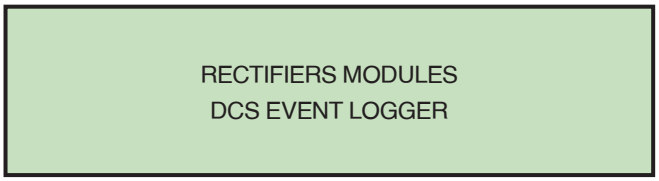
With the character to «0», means that there is not communication with that module address, either because the communication has been lost or because the module is not installed. With the character to «1», means that the communication with that module address is correct. If the Control Module losses the communication with one module, the communication fault alarm is activated, causing an input in the data logger of the modules showing the date, time, affected module, etc.

In the above example screen, the modules 1, 2, 3, 4, 5, 6 and 9 have a correct communication and the rest ones don't communicate because they are not installed. For those cases that there is a module installed and its corresponding character address is «0», it means that the communication between the central system and the module is not correct.

8.4. Data logger of the rectifiers modules.

The screen 10.4 referred to the data logger of the FAC modules (rectifiers), is a mere presentation screen in order to let us know where we are in the menu.

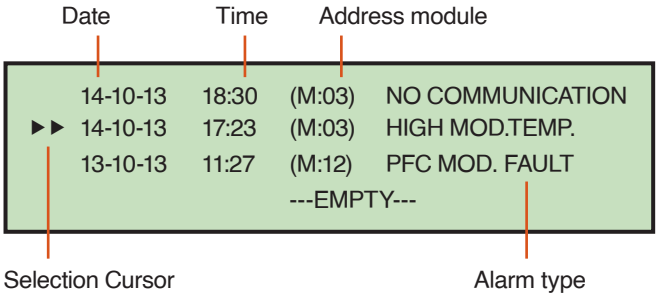
To continue moving forward, use the horizontal scroll key **(►)**.



Screen 10.4

8.5. Event list of modules.

This screen shows the event data logger of the rectifiers modules (rectifiers) in a similar way as the event data logger of the system. When an alarm or an event related with the rectifiers modules happens, it is recorded in this section in order to state the date, time, etc...



Screen 10.6

Using the vertical scroll keys **(▲)** and **(▼)**, the cursor moves to the left and that event of the list is selected. The list is ordered from the recent to the oldest ones.

- **Date**: Date with format dd-mm-yy (days-months-year).
- **Time**: The time when the event happened with format hh:mm (hour:minutes).
- **Module address**: The module address to which belongs the alarm or event.
- **Alarm type**: Description of the alarm in a compact format.

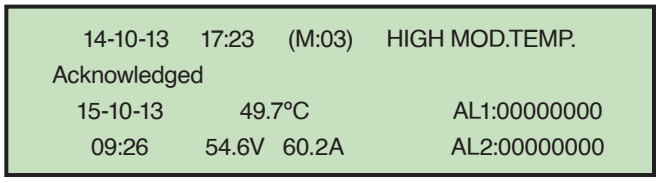
In case there are not any events, it is showed with a line of empty (---EMPTY---).

8.6. Details of the data logger of the rectifiers modules.

Once the event is selected, by pressing the right scroll key **(►)** we have access to its detail screen.

As it is showed, the selected event of the previous screen appears in the first row of it. Next there is some information, which can be divided into three groups:

- **Acknowledged**: In this column of information shows the date and time when the alarm finished. If the alarm is still ON, it shows zeros.
- **Measurements**: In this column of information shows the measurements of output voltage, output current and temperature of the heatsink when the alarm was activated.
- **Alarm**: It is showed the status of each alarm in the module when this alarm was activated. Each character is one alarm of the module. «0» means that the alarm was not active, meanwhile «1» means that it was active. The alarms go from left to right.



Screen 10.7

AL1:

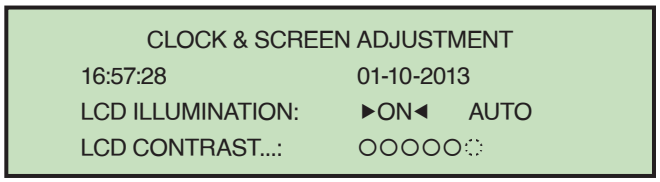
- ❒ Alarm 1: Discharging batteries.
- ❒ Alarm 2: Battery low.
- ❒ Alarm 3: End of autonomy.
- ❒ Alarm 4: Overload.
- ❒ Alarm 5: Output circuit breaker tripped.
- ❒ Alarm 6: High heatsink temperature.
- ❒ Alarm 7: Rectifier fault.
- ❒ Alarm 8: Remote shutdown.
- ❒ Alarm 9: Output over voltage.
- ❒ Alarm 10: PFC over voltage.
- ❒ Alarm 11: Mains fault .
- ❒ Alarm 12: /*RESERVED*/.
- ❒ Alarm 13: /*RESERVED*/.
- ❒ Alarm 14: /*RESERVED*/.
- ❒ Alarm 15: /*RESERVED*/.
- ❒ Alarm 16: /*RESERVED*/.

9. System parameters.

The user can easily set some parameters of the system in these screens.

9.1. General parameters.

The user can set the clock and adjust the LCD (screen).



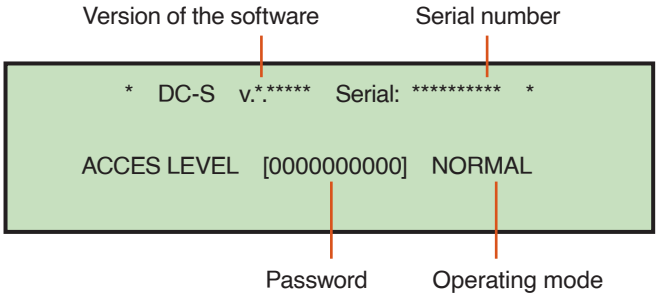
Screen 15.1

This screen allows to set 4 fields:

- **Time**: Allow to set the time. To enter in, just press enter **(ENT)** once, and with the vertical scroll keys **(▲)** and **(▼)** increase or decrease the blinking number of the field. To go to the next field, use the horizontal scroll keys **(◄)** and **(►)**. Press enter **(ENT)** to validate the change.
- **Date**: Allow to set the date, proceed in the same way as the time setting.
- **LCD ILLUMINATION**: Allow to set the backlight of the LCD panel. In «ON» mode, it is always turned on, in «AUTO» mode, it is only turned on when any key is pressed and after a period time of inactivity is turned off.
- **LCD CONTRAST**: Allow to set the contrast of the LCD panel. It is set with a status bar; as much squares in black more contrast, and vice versa.

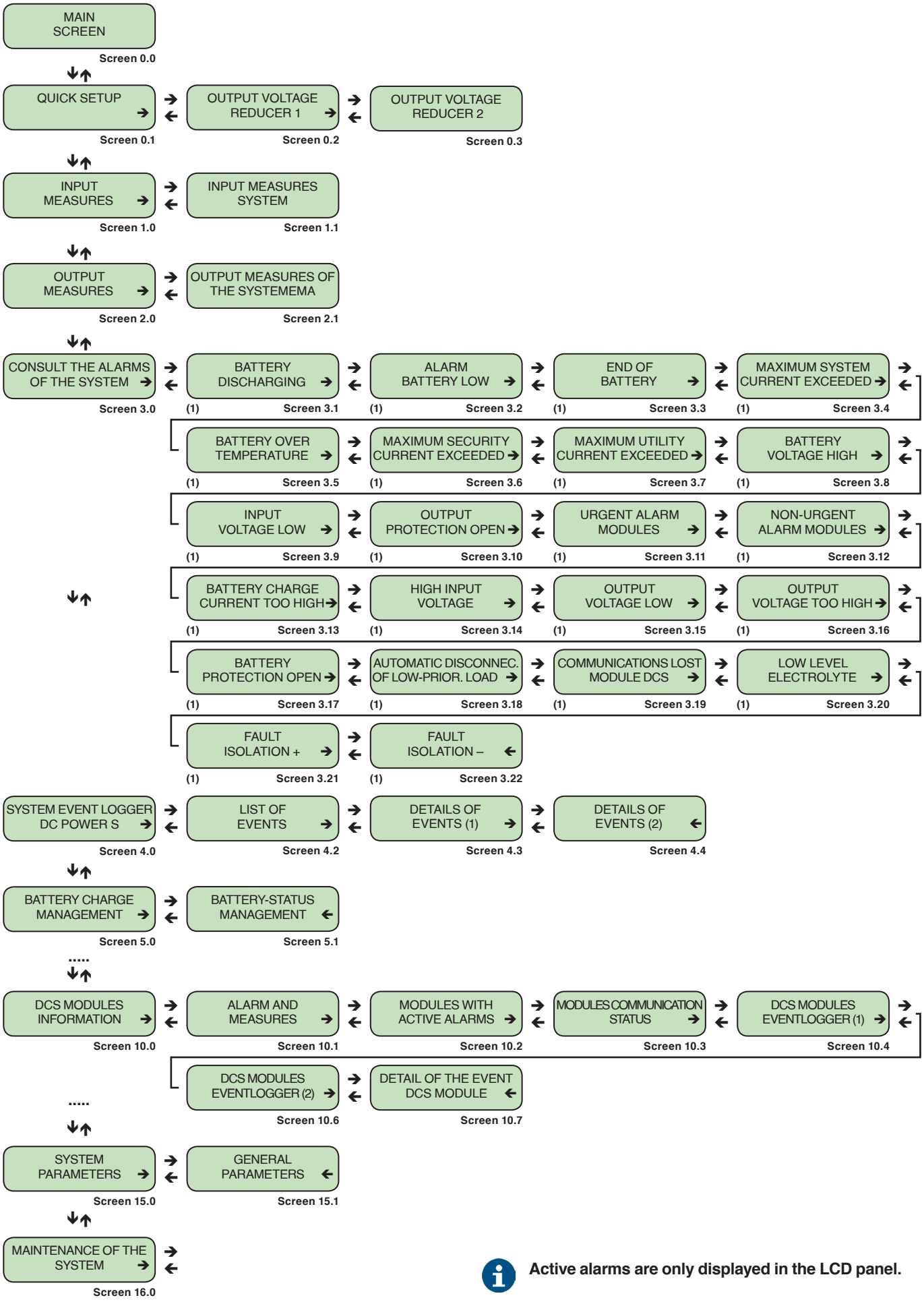
10. Maintenance of the system.

In this screen displays you can see the serial number of the equipment, the software version installed in the control module and the operating mode of the latter, which by default is the NORMAL.



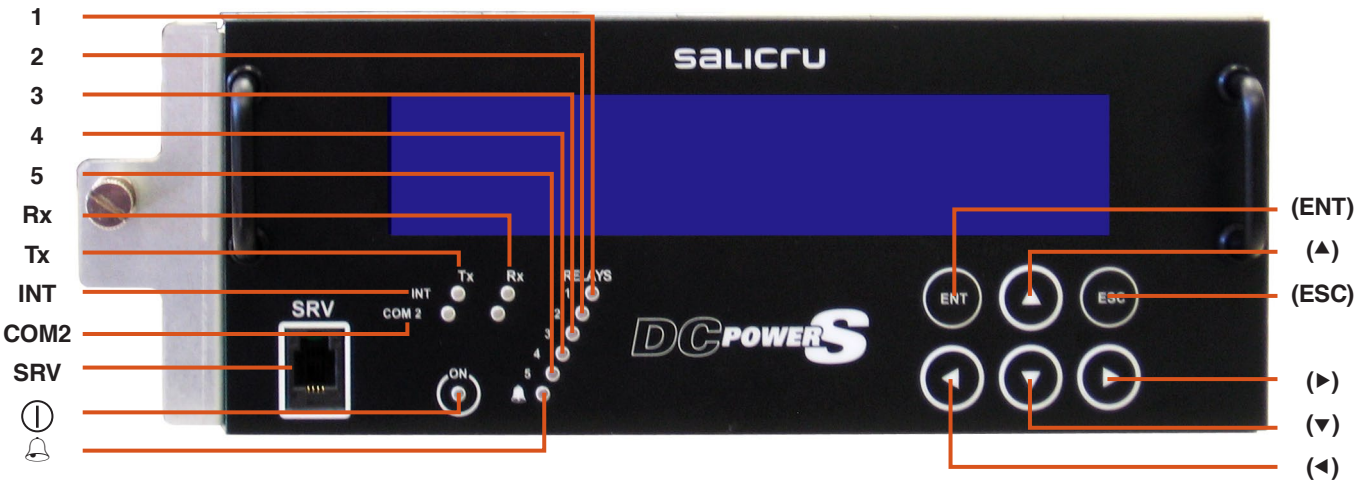
Screen 16.0

11. Map of the screens.



Active alarms are only displayed in the LCD panel.

12. Appendix 1.



12.1. Keypad.

(ENT) Key with function accept.

(▲) Key to move the cursor up.

(ESC) Key with function escape.

(◄) Key to move the cursor to the left.

(▼) Key to move the cursor down.

(►) Key to move the cursor to the right.

12.2. LEDS Indications.

12.2.1. Communication Leds (yellow).

Each communication port has two optical indications, one is the transmitter (Tx) and the other one is the receiver(Rx). The preset values of each port are:

INT Internal communications with the rectifiers modules.

COM2 External communication RS232 or RS485 COM2 and COM3 for the communications module.

12.2.2. Operating (green).

⏀ Control Module supplied and operating.

12.2.3. Relays (red).

(1) Alarm relay A1 activated.

(2) Alarm relay A2 activated.

(3) Alarm relay O1 activated.

(4) - (5) No used.

12.2.4. Alarm (red).

🔔 General alarm, it is activated with any alarm of the equipment.

12.3. Connections.

(SRV) Connector reserved for programming and settings of the factory or for **S.T.S.**.

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