# *wipos UPS 20-960*

**Uninterruptable Power Supply**

**USER MANUAL**

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NOTE

Every effort has been made to ensure that the information contained in this document was complete and accurate at the time of publishing. Nevertheless, the authors retain the right to modify the information. This customer document describes all the hardware units and functions known at the present time. Descriptions may be included for units which are not present at the customer site. The exact scope of delivery is described in the respective purchase contract.

Conformity Information

For more information regarding CE marking and Declaration of Conformity (DoC), please contact your local Wieland Electric customer service organization.

$C\epsilon$

Technical support

Up-to-date information concerning the product is available from the following websites:
http://www.wieland-electric.com/
http://eshop.wieland-electric.com/

Technical support

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# 1 About this manual

Please read this section carefully before you use this manual and the *wipos* UPS from Wieland. Here you will find all the information required for commissioning and operation.

## 1.1 Target groups and qualification of personnel

Commissioning and installation of components for such types of installations must be considered.

Therefore, the system manual is targeted at the following:

- Those who can verify that they have the corresponding training and already have corresponding basic knowledge
- System integrators
- Electricians

## 1.2 Structure of the manual

As a guidance the overall table of contents is available in the manual at the beginning.

## 1.3 Presentation of safety-relevant information

Information that warns of personal injury or property damage are emphasized by safety instructions. Please read this information carefully.

This operating manual uses various safety notices that are assigned according to the severity of a potential hazard:

| | |
|---|---|
| **Danger!**<br><br>**Immediate or likely danger. Personal injury or death is possible.** | DANGER |
| **Warning!**<br><br>Possible danger. Not heeding this warning can lead to minor injuries. | WARNING |
| **Attention!**<br><br>Damages to property is likely if these warnings are not heeded. | ATTENTION |
| **NOTE:**<br><br>Supplementary information and useful tips, indirectly related to the safety of personnel or property. | NOTE |

"Danger" or "Warning" are strictly used for cases which present a risk to life or limb. Damage to property only falls into these categories if there is also a risk of personal injury that corresponds to these levels.

Please, observe the following instructions:

**NOTE:**

Personnel which installs, programs, operates or maintains this device must have read and understood these instructions.

**Warning**!

The personnel must be thoroughly familiar with all warnings, notes and procedures described in these operating instructions.

Where necessary, safety precautions and safety devices must comply with the applicable regulations.

Damaged products must neither be installed nor put into operation. In case of a defect, please return the device to Wieland Electric.

The unit must not be opened.

Do not insert any objects into the unit!

Keep the unit away from fire and water

WARNING

**Attention**!

Ensure appropriate installation before start of operation.

Do not cover any air ventilation holes.

Use the device only as intended.

ATTENTION

# 2 Product disposal instructions

The WEEE (Waste Electrical and Electronic Equipment) directive has been introduced to ensure that electrical/electronic products are recycled using the best available recovery techniques to minimize the impact on the environment.

This product contains high quality materials and components which can be recycled. At the end of its life this product MUST NOT be mixed with other commercial waste for disposal. Check the terms and conditions of your supplier for disposal information.

# 3  Product description

> **NOTE:**
> Use latest device Documentation, Software and Firmware to ensure reliable operation of the system (down-loadable from www.wieland-electric.com).

The UPS 20-960 is a microprocessor controlled unit that can perform two functions:

- UPS rated 960 W / 20 A usable in any system rated 12 … 48 V DC
- DC-DC converter (non-isolated) rated 960 W / 20 A usable in any combination of IN/OUT voltages 12 … 48 V DC

For the UPS function, it may use a battery of 12 V, independently of the operating load voltage. For any supply voltages (12 … 48 V DC) it may use also multiple battery configuration (10 … 58 V DC). The UPS module monitors the voltage coming from a DC power supply and in case of power failure a backup battery is supplying the energy to the load. In normal condition the battery is kept charged by an integrated battery charger supporting various battery chemistries.

As a DC-DC converter (no battery present) the input must be connected to the battery connector. The input voltage is converted to any output voltage as per the set-up.

## 3.1 Overview of the UPS module's front
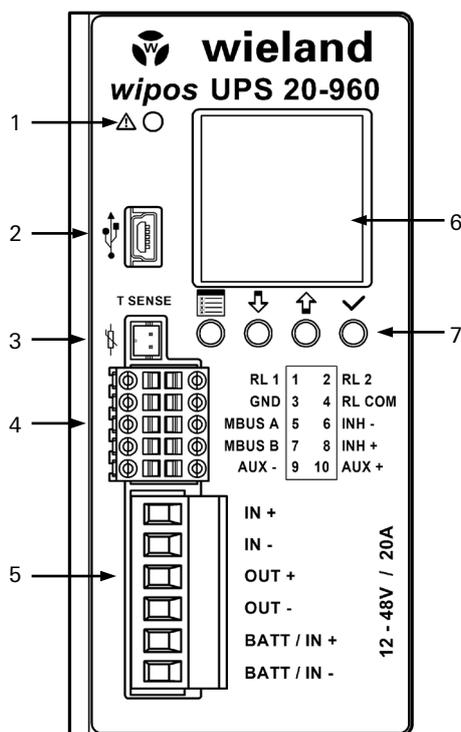


*Figure 1 Front panel view*

1. **Alarm LED indicator**: ON when the unit is in backup. Blinks at 1 Hz rate in case of error.
2. **Modbus over USB**: Used to connect a PC with user software or custom application for remote monitoring and controlling. Firmware update is also possible through USB connection.
3. **Temperature sensor**: Optional temperature sensor (*wipos* UPS 20 Sensor) to measure the battery temperature for protection and temperature compensated charge method.
4. Terminal block 1
5. Terminal block 2
6. **Display area:** provides information regarding the device status.
7. **Control keys:** 4 push buttons are provided to navigate through the menus and to select the various functions.



*Figure 2 Terminal block 1*

8. **Relays dry contacts:** 2 relays (signal contacts) are present for remote monitoring. See no. 26 in section 6.2 for more details.
9. **Modbus over RS485:** Used to connect a PC with user software or custom application for remote monitoring and controlling. Firmware update is also possible through RS485 connection.
10. **Inhibit input:** A voltage between 5 V DC and 30 V DC applied to this input activates the inhibit function. See section 5.4 for more details.
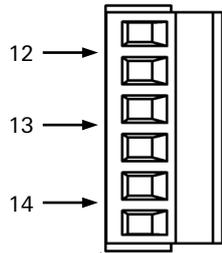
*Figure 3 Terminal block 2*

11. **Auxiliary output supply:** Maximum 5 A supply from the battery (unregulated).

12. **Input connection:** 2 connectors are provided for input connection. This must be connected to a power supply rated 12 … 48 V DC.

13. **Output connection:** 2 connectors are provided for output connection. It must be connected to the load to be backed up.

14. **Battery / DC-DC input connection:** 2 connectors are provided for battery connection. This must be connected to the battery in UPS mode or to the power supply in DC-DC mode. Although the unit is protected the correct polarity must be respected

# 4 Features and benefits

The main features are:

- Integrated battery charger for 12 … 48 V DC multi-chemistries batteries with a charging current up to 20 A
- Can be operated with SUPERCAP capacitors instead of batteries
- 20 A or 960 W rated load
- Automatic sensing of input voltage, load current and battery current
- Battery protection against reverse polarity connection and overcurrent
- Battery health monitoring system: measuring battery resistance, battery temperature, charge/discharge cycles and Coulomb counter
- User settable maximum backup time
- Remote inhibit input
- Connection for a battery thermal sensor (optional)
- Modbus over USB and RS485 interfaces for control and monitoring
- Auxiliary output from the battery voltage (max. 5 A), protected against overcurrent/short circuit
- Suitable for energy management applications
- Suitable for user software

Embedded user interface:

- 4 keys and 1 color graphic LCD display
- Allows online device configuration
- Displays the UPS module's status, logs and alarms
- 2 dry contacts for programmable status signals

PC user software used for:

- Connection through Modbus
- Remote monitoring and configuration
- Firmware upgrade
- Same functionalities of the embedded user interface with the ease of the PC benefits

# 5 Function description

The UPS 20-960 is a high performance digitally controller DC-UPS that can be used in any DC system with a rated voltage between 12 V and 48 V and up to 20 A.

At the core of the device a bidirectional DC/DC buck-boost converter (see Figure 4) acts as a battery charger when the input supply is present. In case of a power outage (backup) the converter keeps the output voltage regulated draining power from the battery. The converter is digitally controlled.
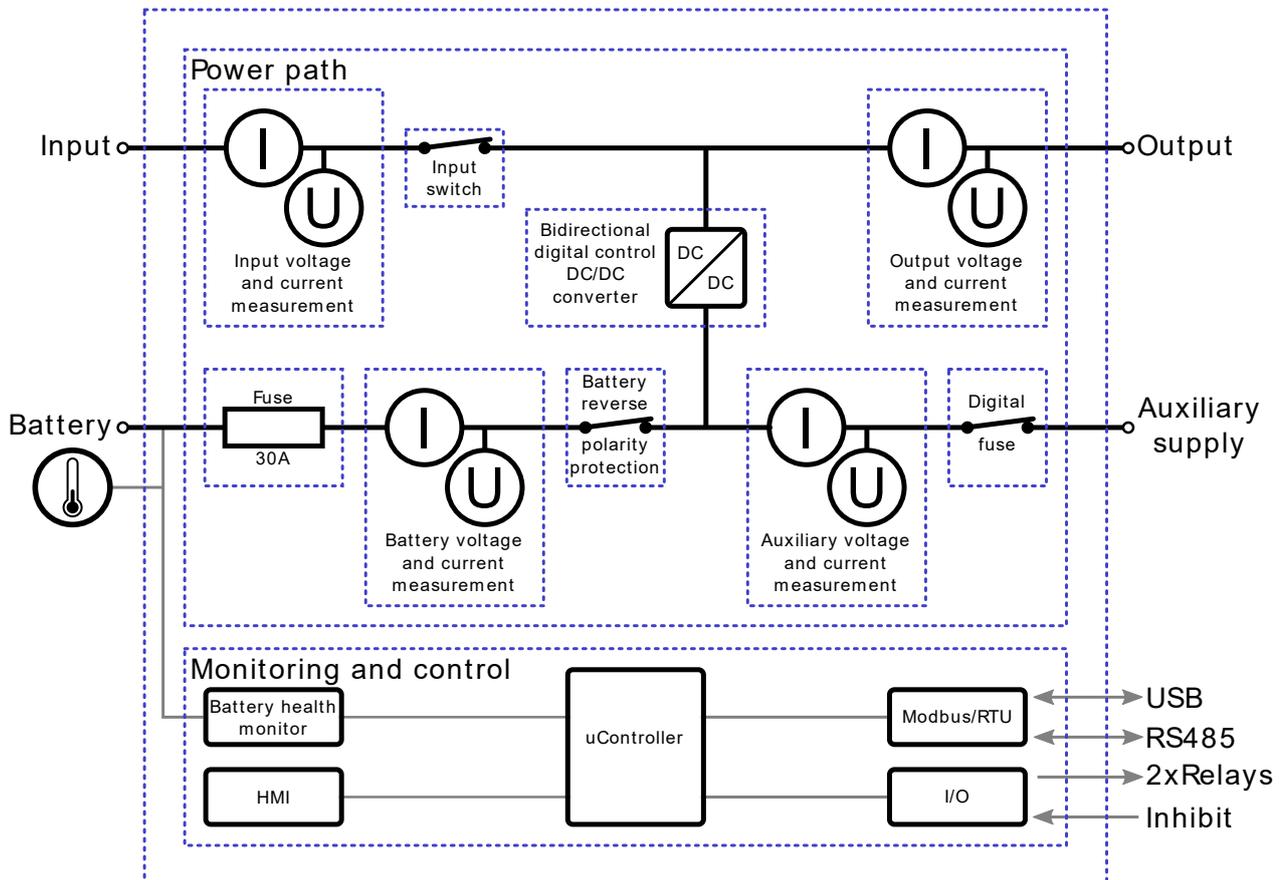


*Figure 4 Simplified block diagram for UPS 20-960*

# 5.1 UPS mode
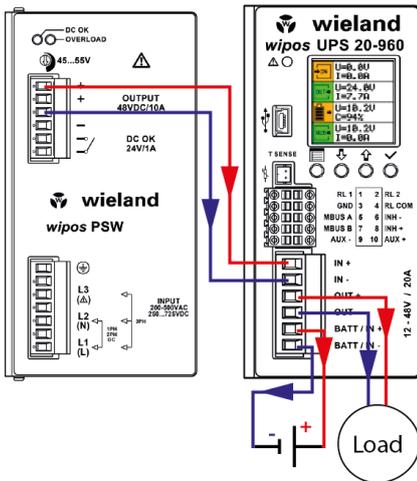


*Figure 5 UPS connection example*

In UPS mode the UPS module protects a load from unwanted power interruption in case of mains failure. An example of UPS connection is given in Figure 5.

When the input is present, the UPS module acts as a bypass, connecting the input to the output via the input switch. Meanwhile, if required, the battery is charged. During bypass there is no voltage conversion, therefore the output supply voltage is equal to the input voltage.

In case of power outage, the UPS module takes energy from the battery to keep the output regulated at nominal output voltage. See no. 20 in section 6.2 for more details.

## 5.1.1 Backup (battery mode)

The system is in backup mode if the supply for the output is sourced from the battery (input supply missing). During backup the battery is monitored continuously to prevent over discharge.

A **programmable backup timer** is also implemented in order to fix a maximum backup time during power outages. This allows preserving the battery life and shortening the recharge time, avoiding discharging the battery when not needed. See no. 24 in section 6.2 for more details.

During backup the internal Coulomb counter is used to give an estimation of the residual charge of the battery.

Backup starts when the output voltage is lower than 90% of the nominal output voltage. See no. 20 in section 6.2 for more details.

## 5.1.2 Battery health monitor

The battery health monitor is composed of:

- Internal resistance measurement: The resistance is periodically measured. The internal resistance is a good indicator of the battery health status; a sudden increase of the internal resistance indicates a potential problem on the battery or on the battery wiring.

- Temperature measurement: The battery temperature is monitored through an optional temperature sensor (*wipos* UPS 20 Sensor). The battery charger takes into account the battery temperature and provides a temperature compensated charging voltage. In case of over or under temperature the system disconnects the battery to prevent damage.

- Coulomb counter: Estimates the remaining battery capacity and consequently the available backup time.

- Deep discharge protection: It protects against the deep discharge of the battery which can lead to its irreversible damage.

The battery internal resistance (Ri) is measured by draining a defined AC current through an active load (AL) from the battery and measuring the AC voltage drop across the load terminals. The principle is represented in Figure 6.
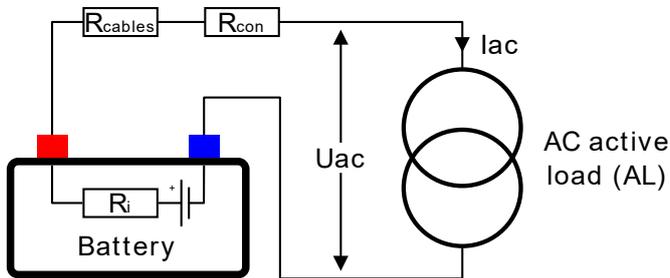


*Figure 6 Internal resistance measurement*

The measured resistance is the sum of the *battery internal resistance*, the *cables resistance* and the *connectors resistance*, therefore cabling problem such as loose connectors are also detected with Ri measurement.

When high capacity batteries and/or small and long cables are used, $R_{cables}+R_{con}$ may be > Ri.

### 5.1.3 Battery charger

The battery charger supports batteries such as Lead-Acid, Nickel, Lithium and Supercapacitors. The charging algorithm for each chemistry is given below.

The battery charger automatically reduces the current to avoid exceeding the maximum input current in case of high current load. See no. 21 in section 6.2 for more details.

The user must set the following parameters to allow the charger to perform correctly:

- Battery type (see no. 5 in section 6.2)
- Battery charge voltage (see no. 6 in section 6.2)
- Battery charge current (see no. 7 in section 6.2)
- Battery float voltage (see no. 8 in section 6.2)

The battery charge terminates in case at least one of the following conditions are satisfied:

- **Low current:** The measured battery charge current is lower than 10% of the battery charge current while the measured voltage is at least 98% of the battery charge voltage.
- **Timer:** the charge is terminated after the battery has been charged for a predetermined amount of time. The value is automatically calculated by the device.

For Nickel batteries only, the following conditions are also checked:

- **Temperature Cutoff (TCO):** The battery temperature if higher than the "Battery maximal temperature" minus 3 °C for more than one minute. See no. 14 in section 6.2 for more details. For example, if the maximal battery temperature is set to 60 °C, the charge terminates in case the temperature is higher than 57 °C.
- **Rate of Temperature Increase (ΔT/dt):** The battery temperature is rising at a rate equal or superior to 1 °C/min. To avoid unattended end of charge do not place the system on an ambient with rapid changes of temperature (for example exposed to direct sunlight).

The charger voltage is independent on the input voltage (power supply), and is user settable.

Lead acid and lithium batteries share the same 3 stages charging algorithm as shown on Figure 7.
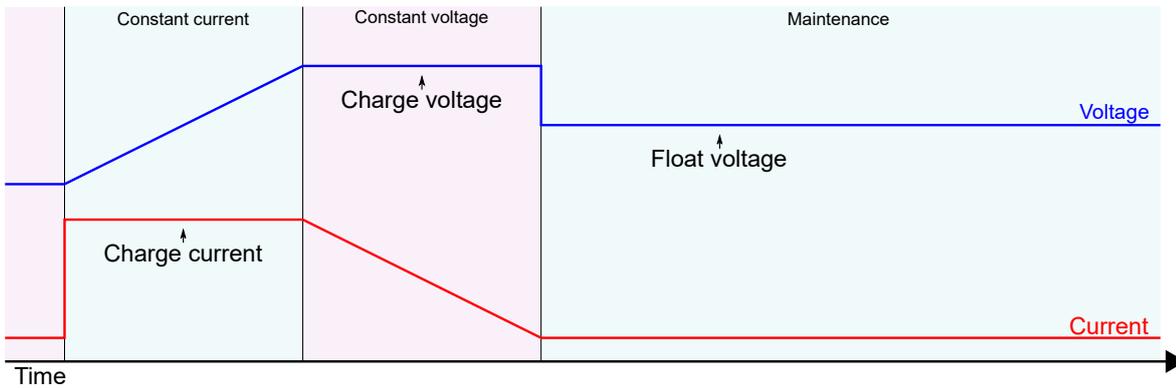
Figure 7 Lead acid and Lithium charging algorithm

For nickel batteries, during maintenance, the UPS module gives pulses of 3 s every 30 s with a maximum current of 1/10 of the battery charge current and maximum voltage equal to the battery charge voltage.
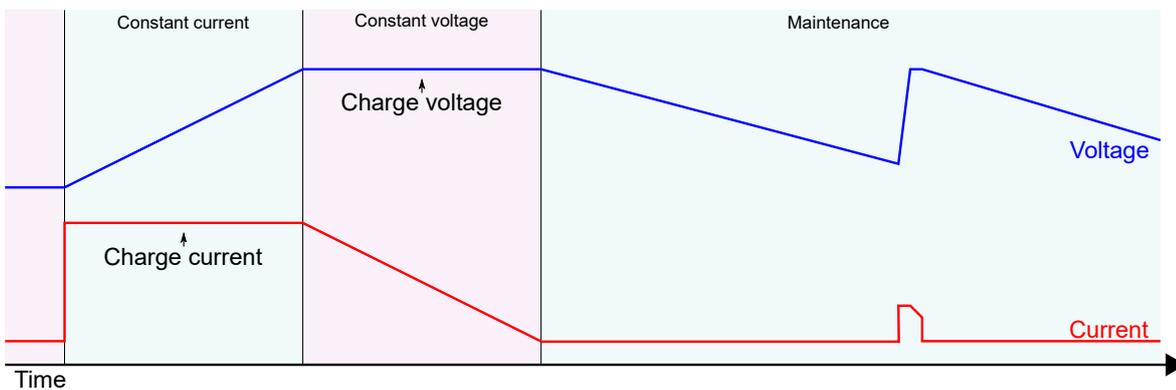
Figure 8 Nickel charging algorithm

For Supercapacitor after the constant current phase the algorithm goes directly to maintenance keeping the voltage at battery charge voltage.
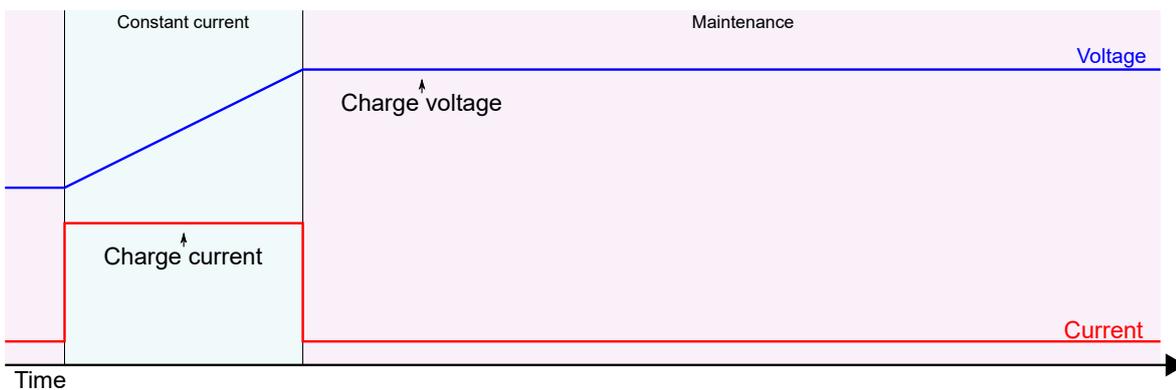
Figure 9 Figure 7: Supercapacitors charging algorithm

**Warning!**

In order to avoid potentially hazardous situations including fire hazard, safety recommendations must be followed. Only authorized staff can install the unit.

**WARNING**

**Warning!**

For Lithium cells the balancing and protection circuit must be included in the battery pack.

**WARNING**

**Warning!**

For Nickel batteries the use of the external temperature sensor is mandatory. The sensor must be placed in contact with the battery.

**WARNING**

## 5.1.4 Coulomb counter

The UPS module measures the current flowing from / to the battery to keep track of the capacity available on the battery. The capacity is measured in Ampere Hour [Ah]. The value shown is based on the following assumptions:

- The value shown is just informative and does not represent the real state of charge of the battery in some circumstances, for example if the battery is damaged.
- When the battery is connected for the first time or the system starts from OFF, the system assumes the battery is fully discharged and start with 0 Ah counter.
- Once the battery is fully charged the system sets the counter to the nominal capacity specified by the user. See no. 12 in section 6.2 for more details.

## 5.1.5 PC shutdown and automatic restart

**PC shutdown:** In case the UPS module is used to supply a PC it is possible to automatically shut down the PC after an adjustable time of backup. For this the PC must run the user software and must be connected through Modbus. Optionally the user software can call a task on the PC before shutting down, for example to backup some sensitive data.

**Automatic restart:** UPS module is able to automatically restart a PC which was powered OFF by mistake, for example in case of the Operating System (OS) crash. The user may adjust an output current threshold and a timer used for detecting the PC OFF status. In order to restart the PC, the UPS module toggles the output OFF and then ON again. User must enable in the PC BIOS the automatic start in case of supply ON.

The diagram below shows the UPS module's behavior when Shutdown and Automatic restart is enabled.
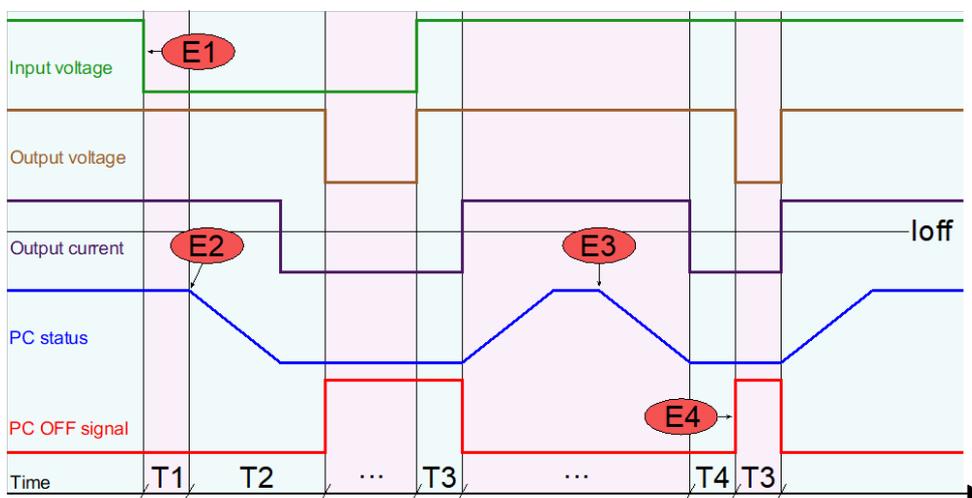


*Figure 10 Shutdown and restart chart*

| Parameter | Name | Description |
|-----------|------|-------------|
| E1 | *Backup* | Power failure on the line happens. System enters backup mode. |
| E2 | *Automatic PC shutdown* | The user software sends a shutdown command to the PC. Optionally: a task is called before shutdown. |
| E3 | *Unexpected PC shut-down* | The PC shutdowns in an unexpected way, for example caused by OS crash. |
| E4 | *PC restart* | The UPS module detects the PC being OFF because the output current was lower than Ioff current threshold for T4 time. As a consequence, the UPS module generates an ON->OFF->ON cycle on its output. |
| T1 | *PC shutdown delay* | User settable (see no. 36 in section 6.2). Time between start of backup and start of PC shutdown procedure. |
| T2 | *PC shutdown time* | User settable (see no. 37 in section 6.2). Time between start of shutdown procedure and output voltage OFF. This time must be set longer than the maximum time the PC takes to complete the shutdown. |
| T3 | *PC restart minimum* OFF *time* | User settable (see no. 38 in section 6.2). T3 is the delay used between the return of the input voltage and the activation of the output. The same time is used by the automatic restart function as power OFF time to restart the PC. The value must be big enough for the PC to detect the supply ON->OFF->ON cycle to restart. |
| T4 | *PC* OFF *detection timer* | User settable (see no. 40 in section 6.2). Minimum time at which the output current must be below the Ioff current threshold to trigger the automatic PC restart (PC supply ON->OFF->ON cycle). |
| Ioff | *PC* OFF *detection current threshold* | User settable (see no. 39 in section 6.2). Current threshold used to detect PC OFF status. This value must be lower than the minimum PC current consumption when this is ON. |

*Table 1 Shutdown and restart*

The parameters are settable through the UPS module user interface or using the user software. The checkbox "Run on startup" must be checked in the user software when PC shutdown function is used. To inhibit the software from calling the shutdown command, the user can select the "Inhibit shutdown" check box.

## 5.1.6 Cold start

The cold start is a procedure that allows turning ON the UPS without the input power. This procedure is used to turn ON the UPS to operate during a power interruption. This practice is also a method to see if the battery connected to the UPS module is functional.

In cold start the UPS module will remain ON for at least 60 seconds independently from the battery voltage (even when being under the deep discharge threshold), the inhibit input and the backup timer.

After the first 60 seconds the device stays ON until the battery is not deep discharged, the backup timer is not expired or the inhibit input is not active.

When cold started, the "Cold start" text is written beside the input icon on the status screen.

If the input supply returns during cold start, the device reverts to normal operation.

To cold start the device the user has the following options:

- **From front panel:** Press and hold simultaneously the ▤ and ⇧ buttons until you see the welcome message on the screen.
- **Remotely through inhibit input:** When enabled on the user setting (see no. 32 in section 6.2), the device can be cold stared toggling the inhibit status from true to false.

- • **On battery connection:** When enabled on the user settings (see no. 33 in section 6.2), the device automatically cold starts when the battery, previously disconnected, is connected to the device.

### 5.1.7 Blink output on backup

When this option is enabled, during backup, the output voltage switches on/off periodically with the timing defined on "Blink output on backup Ton" and "Blink output on backup Toff" (see no. 42 and no. 43 in section 6.2). This function may be used on illumination application where is necessary to inform the person in the building that the lighting is running on batteries.

# 5.2 DC-DC mode

The UPS module can be used as a high performance DC-DC converter. An example of DC-DC connection is given on Figure 11.

Any voltage between 10 V to 55 V can be converted to any voltage between 10 V to 55 V (step-up and step-down operation) with up to 20 A input or output current.

Input and output are protected against over current with user settable limits. See section 5.3 for more details.

When used as a DC-DC converter, the input supply must be connected to the battery connector as shown on Figure 11.
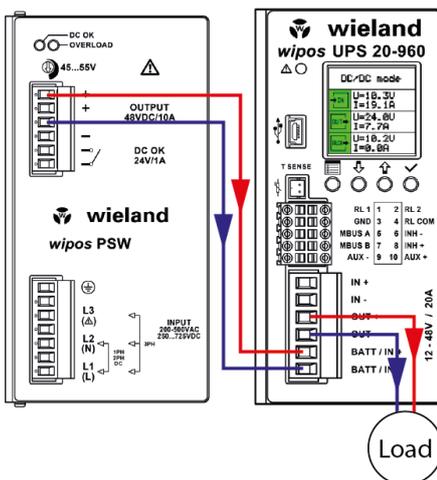


*Figure 11 DC-DC connection example*

## 5.3 Current limit

The UPS module has the ability to limit the current flowing through its input, output and battery terminals to a user settable threshold.

### 5.3.1 Current limit in UPS mode

In UPS mode the UPS module provides 4 different settings for the current limit:

- **Maximum input current** (see no. 21 in section 6.2), default 20 A: it is used to limit the input current at a specified threshold. For example, if the DC power supply is rated less than 20 A, the threshold can be lowered to avoid too high current drain from the power supply. When the input current limit is reached, the battery charging current is limited. If the input current cannot be kept below the threshold due to excessive loading, an input overcurrent alarm is triggered. When the input current is approaching the threshold, the measured input current is displayed with red fonts on the LCD.

- **Maximum output current** (see no. 22 in section 6.2), default 20 A: it is used to limit the maximum current delivered to the load. When the threshold is reached due to excessive loading, an output overcurrent alarm is triggered. When the output current is approaching the threshold, the measured output current is displayed with red fonts on the LCD.

- **Battery maximum charge current** (see no. 7 in section 6.2), default 0.5 A (maximum settable 20 A): it is used to limit the maximum charge current supplied to the battery. This threshold will be automatically reduced in such manner that the maximum input current limit (see no. 21 in section 6.2) is distributed to the load with priority towards the charging.

  For example, if the maximum input current limit is 20 A and the load needs 10 A while the maximum charge current is set at 12 A, the controller will limit the charging current automatically to 10 A until the load will need <10 A.

- **Battery maximum discharge current** (see no. 11 in section 6.2), default 20 A: it is used to limit the maximum discharge current delivered from the battery during the backup function. When the threshold is reached due to excessive loading, a battery overcurrent alarm is triggered and the output voltage starts to decrease. When the battery discharge current is approaching the threshold, the measured battery current is displayed with red fonts on the LCD.

### 5.3.2 Current limit in DC-DC mode

In DC-DC mode the UPS module provides 2 different settings for the current limit:

- **Maximum input current** (see no. 21 in section 6.2), default 20 A: it is used to limit the input current at a specified threshold. For example, if the DC power supply is rated less than 20 A, the threshold can be lowered to avoid too high current drain from the power supply. When the input current limit is reached due to excessive loading, an input overcurrent alarm is triggered. When the input current is approaching the threshold, the measured input current is displayed with red fonts on the LCD.

- **Maximum output current** (see no. 22 in section 6.2), default 20 A: it is used to limit the maximum current delivered to the load. When the threshold is reached due to excessive loading, an output overcurrent alarm is triggered and the output voltage starts to decrease. When the output current is approaching the threshold, the measured output current is displayed with red fonts on the LCD.

## 5.4 Inhibit

An **opto-isolated input** allows the inhibition of the backup function in UPS mode or switching off the output on DC-DC mode. The polarity of the input can be defined using the "Inhibit polarity" field. See no. 28 in section 6.2 for more details.

## 5.5 Modbus

The UPS module communicates through Modbus/RTU as specified on "MODBUS over Serial Line" and "MODBUS APPLICATION PROTOCOL SPECIFICATION" documents available on http://www.mod-bus.org/.

Table 2 contains the field types and Table 3 the mapped fields. For types bigger than 16 bit, access all registers in one transaction (multiple register read or write) to ensure atomic operation.

| Type | Modbus function codes | | Description |
|---|---|---|---|
| | **Read** | **Write** | |
| BIT | 1,2 | 5,15 | Single bit with value 0 or 1 |
| SINT16 | 3,4 | 6,16 | Signed 16 bit value (2's complement) |
| UINT16 | 3,4 | 6,16 | Unsigned 16 bit value |
| SINT32 | 3 | 16 | Signed 32 bit value (2's complement) Composed of 2 consecutive registers in big-endian order. |
| UINT32 | 3 | 16 | Unsigned 32-bit value. Composed of 2 consecutive registers in big-endian order. |
| DATE | 3 | 16 | Time and date field. Composed of 4 Modbus registers as follows: <table><tr><th>Address offset</th><th>Byte</th><th>Description</th></tr><tr><td>0</td><td>MSB</td><td>Reserved, set to 0</td></tr><tr><td></td><td>LSB</td><td>Year-2000</td></tr><tr><td>1</td><td>MSB</td><td>Month (1=January)</td></tr><tr><td></td><td>LSB</td><td>Day of the month</td></tr><tr><td>2</td><td>MSB</td><td>Hour of the day (24h format)</td></tr><tr><td></td><td>LSB</td><td>Minutes</td></tr><tr><td>3</td><td>MSB</td><td>Milliseconds</td></tr><tr><td></td><td>LSB</td><td></td></tr></table> |

*Table 2 Modbus types*

| Address | Type | R/W | Unit | Min. | Max. | Description |
|---|---|---|---|---|---|---|
| **Common** | | | | | | |
| 0x0010 | DATE | R/W | | | R/W | Real time clock |
| **Settings (see section 6.2)** | | | | | | |
| 0x1000 | UINT16 | R/W | 1 | 1 | 247 | Modbus address |
| 0x1001 | UINT16 | R/W | 1 | 1 | 5 | Modbus baud rate<br>1: 9600 baud<br>2: 19200 baud<br>3: 38400 baud<br>4: 57600 baud<br>5: 115200 baud |
| 0x1002 | UINT16 | R/W | 1 | 1 | 3 | Modbus parity<br>1: None<br>2: Even<br>3: Odd |
| 0x1003 | UINT16 | R/W | 1 | 1 | 2 | Modbus stop bits |
| 0x1010 | UINT16 | R/W | 1 | 1 | 4 | Battery type<br>1: Lead<br>2: Nickel<br>3: Lithium<br>4: Supercapacitor |
| 0x1011 | UINT16 | R/W | 0.1 V | 10 | 58 | Battery charge voltage |

| Address | Type | R/W | Unit | Min. | Max. | Description |
|---------|------|-----|------|------|------|-------------|
| 0x1012 | UINT16 | R/W | 0.1 A | 0.5 | 20 | Battery charge current |
| 0x1013 | UINT16 | R/W | 0.1 V | 10 | 58 | Battery float voltage |
| 0x1014 | UINT16 | R/W | 0.1 V | 5 | 58 | Battery low voltage |
| 0x1015 | UINT16 | R/W | 0.1 V | 5 | 58 | Battery deep discharge voltage |
| 0x1016 | UINT16 | R/W | 0.1 A | 5 | 21 | Battery max. discharge current |
| 0x1017 | UINT16 | R/W | 0.1 Ah | 1 | 200 | Battery capacity - Supercap capacitance |
| 0x1018 | SINT16 | R/W | 1 °C | -40 | 60 | Battery min. temperature |
| 0x1019 | SINT16 | R/W | 1 °C | -40 | 60 | Battery max. temperature |
| 0x101A | UINT16 | R/W | 1 kh | 1 | 100 | Battery lifetime |
| 0x101B | UINT16 | R/W | 1 | 0 | 3 | Ri alarm mode<br>0: Disabled<br>1: Fix<br>2: Automatic<br>3: Automatic done |
| 0x101C | UINT16 | R/W | 0.1 m© | 0 | 300 | Ri nom |
| 0x101D | UINT16 | R/W | 1% | 50 | 300 | Ri max. variation |
| 0x1020 | UINT16 | R/W | 1 | 1 | 2 | Operating mode<br>1: UPS<br>2: DC-DC |
| 0x1021 | UINT16 | R/W | 0.1 | 10 | 58 | Nominal output voltage |
| 0x1022 | UINT16 | R/W | 0.1 | 5 | 21 | Max. input current |
| 0x1023 | UINT16 | R/W | 0.1 | 1 | 21 | Max. output current |
| 0x1024 | UINT16 | R/W | 1 | 0 | 1 | Max. Backup time enable<br>0: Disabled<br>1: Enabled |
| 0x1025 | UINT16 | R/W | 1 m | 1 | 1440 | Max. backup time. |
| 0x1026 | UINT16 | R/W | 1 | 0 | 1 | Buzzer enable<br>0: Disabled<br>1: Enable |
| 0x1027 | UINT16 | R/W | 1 | 0 | 65535 | Relay 1 configuration (see no. 27 in section 6.2) |
| 0x1028 | UINT16 | R/W | 1 | 0 | 65535 | Relay 2 configuration (see no. 27 in section 6.2) |
| 0x1029 | UINT16 | R/W | 1 | 1 | 2 | Inhibit polarity<br>1: Low<br>2: High |
| 0x102A | UINT16 | R/W | 1 | 1 | 2 | DC-DC output mode<br>1: Single<br>2: Parallel |
| 0x102B | UINT16 | R/W | 1 | 0 | 1 | Output enable<br>0: Disabled<br>1: Enabled |
| 0x102C | UINT16 | R/W | 1 | 0 | 1 | Aux enable<br>0: Disabled<br>1: Enabled |
| 0x102D | UINT16 | R/W | 1 | 0 | 1 | Cold start on inhibit toggle<br>0: Disabled<br>1: Enabled |
| 0x102E | UINT16 | R/W | 1 | 0 | 1 | Cold start on battery connection<br>0: Disabled<br>1: Enabled |
| 0x1030 | UINT16 | R/W | 1 | 0 | 1 | PC shutdown enable |

| Address | Type | R/W | Unit | Min. | Max. | Description |
|---|---|---|---|---|---|---|
| | | | | | | 0: Disabled<br>1: Enabled |
| 0x1031 | UINT16 | R/W | 1 | 0 | 1 | PC automatic restart enable.<br>0: Disabled<br>1: Enabled |
| 0x1032 | UINT16 | R/W | 1 s | 1 | 3600 | PC shutdown delay |
| 0x1033 | UINT16 | R/W | 1 s | 1 | 600 | PC shutdown time |
| 0x1034 | UINT16 | R/W | 1 s | 1 | 60 | PC restart minimum time |
| 0x1035 | UINT16 | R/W | 0.1 A | 0 | 20 | PC off detection current threshold |
| 0x1036 | UINT16 | R/W | 1 s | 1 | 60 | PC off detection timer |
| 0x1040 | UINT16 | R/W | 1 | 0 | 1 | Blink output on backup enable<br>0: Disabled<br>1: Enabled |
| 0x1041 | UINT16 | R/W | 1 s | 10 | 600 | Blink output on backup Ton |
| 0x1042 | UINT16 | R/W | 0.1 s | 0.1 | 60 | Blink output on backup Toff |
| 0x1043 | UINT16 | R/W | 1 | 0 | 1 | Output short circuit latch enable<br>0: Disabled<br>1: Enabled |
| 0x1044 | UINT16 | R/W | 0.1 V | 3 | 58 | Output short circuit detection voltage threshold |
| 0x1045 | UINT16 | R/W | 1 | 0 | 1 | High inrush load enable<br>0: Disabled<br>1: Enabled |
| 0x1100 | DATE | R/W | 1 | 0 | 1 | Battery installation date |
| 0x1104 | UINT16 | R/W | 1 | 0 | 65535 | Battery charge cycles |
| Metering | | | | | | |
| 0x2000 | SINT16 | R | 0.1 V | 0 | 60 | Input voltage |
| 0x2001 | SINT16 | R | 0.1 A | 0 | 40 | Input current |
| 0x2002 | SINT16 | R | 0.1 V | 0 | 60 | Output voltage |
| 0x2003 | SINT16 | R | 0.1 A | 0 | 40 | Output current |
| 0x2004 | SINT16 | R | 0.1 V | 0 | 60 | Battery voltage |
| 0x2005 | SINT16 | R | 0.1 A | -25 | 25 | Battery current |
| 0x2006 | SINT16 | R | 0.1 V | 0 | 60 | Auxiliary voltage |
| 0x2007 | SINT16 | R | 0.1 A | 0 | 20 | Auxiliary current |
| 0x2008 | SINT16 | R | 0.1 °C | -40 | 85 | External temperature |
| 0x2009 | SINT16 | R | 0.1 m© | 0 | 3000 | Battery internal resistance |
| 0x200A | SINT16 | R | 0.1 % | 0 | 100 | Battery charge percent |
| 0x200B | SINT16 | R | 0.1 Ah | 0 | 10000 | Battery charge capacity |
| 0x2010 | UINT16 | R | 1 cycle | 0 | 65535 | Boot cycles |
| 0x2020 | UINT32 | R | 1 h | 0 | 500000 | Operating time |
| 0x2022 | UINT32 | R | 1 h | 0 | 500000 | Battery operating time |
| Commands | | | | | | |
| 0x3000 | BIT | W | 1 | 0 | 1 | Perform Ri measurement |
| 0x3001 | BIT | W | 1 | 0 | 1 | Shutdown |
| 0x3002 | BIT | W | 1 | 0 | 1 | Reset device |
| State (see section 6.4) | | | | | | |
| 0x4000 | BIT | R | 1 | 0 | 1 | Battery charging |
| 0x4001 | BIT | R | 1 | 0 | 1 | Battery floating |
| 0x4002 | BIT | R | 1 | 0 | 1 | Battery discharging |
| 0x4010 | BIT | R | 1 | 0 | 1 | Battery disconnected |

| Address | Type | R/W | Unit | Min. | Max. | Description |
|---------|------|-----|------|------|------|-------------|
| 0x4011 | BIT | R | 1 | 0 | 1 | Battery Ri too high |
| 0x4012 | BIT | R | 1 | 0 | 1 | Battery undertemperature |
| 0x4013 | BIT | R | 1 | 0 | 1 | Battery overtemperature |
| 0x4014 | BIT | R | 1 | 0 | 1 | Battery lifetime elapsed |
| 0x4015 | BIT | R | 1 | 0 | 1 | Battery charge failure |
| 0x4016 | BIT | R | 1 | 0 | 1 | Battery SoC <25% |
| 0x4017 | BIT | R | 1 | 0 | 1 | Battery over discharge current |
| 0x4018 | BIT | R | 1 | 0 | 1 | Battery low |
| 0x4019 | BIT | R | 1 | 0 | 1 | Battery deep discharged |
| 0x4020 | BIT | R | 1 | 0 | 1 | USB powered |
| 0x4021 | BIT | R | 1 | 0 | 1 | Cold start |
| 0x4022 | BIT | R | 1 | 0 | 1 | PC shutdown |
| 0x4023 | BIT | R | 1 | 0 | 1 | PC power off |
| 0x4024 | BIT | R | 1 | 0 | 1 | External temperature sensor presence |
| 0x4025 | BIT | R | 1 | 0 | 1 | Inhibit |
| 0x4026 | BIT | R | 1 | 0 | 1 | Output disabled |
| 0x4027 | BIT | R | 1 | 0 | 1 | Auxiliary output disabled |
| 0x4030 | BIT | R | 1 | 0 | 1 | Backup |
| 0x4031 | BIT | R | 1 | 0 | 1 | Input undervoltage |
| 0x4032 | BIT | R | 1 | 0 | 1 | Input overvoltage |
| 0x4033 | BIT | R | 1 | 0 | 1 | Output undervoltage |
| 0x4034 | BIT | R | 1 | 0 | 1 | Output overvoltage |
| 0x4035 | BIT | R | 1 | 0 | 1 | Output overload |
| 0x4036 | BIT | R | 1 | 0 | 1 | Input overcurrent |
| 0x4037 | BIT | R | 1 | 0 | 1 | Auxiliary output overload |
| 0x4038 | BIT | R | 1 | 0 | 1 | External temperature sensor error |
| 0x4039 | BIT | R | 1 | 0 | 1 | Backup time left <25% |
| 0x403A | BIT | R | 1 | 0 | 1 | Warning overtemperature |
| 0x403B | BIT | R | 1 | 0 | 1 | Error overtemperature |

*Table 3 Modbus fields*

# 6 User interface

| | |
|---|---|
| **Power ON screen**<br>This screen is shown at power ON.<br>It shows the device name, serial number and firmware version. | ```001.000.000```<br>```Aug 18 2016```<br>```1623.908.01.```<br>```00321.NNXA1``` |
| **Status**<br>This is the default view where the user can find the most relevant information about the device status. The system always falls back to this view after 60 s of inactivity (no key pressed). | |
| **Settings**<br>All the device settings are configurable from this menu.<br>Use the UP/DOWN key to navigate through the parameters.<br>Press the OK key to enter/exit the editing mode.<br>In editing mode use the UP/DOWN key to change the highlighted value. | |
| **Info**<br>Device information such as firmware version, serial number and device name is visible from this menu. | |
| **Logs**<br>All the alarms and event are logged in a circular buffer and visible from this screen. Use the UP/DOWN key to navigate through the logs. | |
| **Wizard**<br>The wizard helps the user to configure the system through a series of screens. | |

*Table 4 User interface layout*

| Symbol | Name | Function |
|---|---|---|
| ☰ | MENU key | Menu selection / navigation |
| ⇩⇧ | UP/DOWN keys | navigation and selection in menu and to values |
| ✓ | OK key | confirm selection |

*Table 5 User interface keys*

## 6.1 Status

The status screen shows the measurement and statuses to ease the system diagnostic. The screen is divided in sections identified by the symbols shown in Table 6.

| Symbol | Name | Description |
|---|---|---|
| IN | Input | The measured input voltage and current is shown in this section. |
| OUT | Output | The measured output voltage and current is shown in this section. |
| Battery | Battery | The battery voltage, current, temperature, resistance and charge are shown in this section. During charging and discharging the symbol background color changes to orange and the number of bars drawn inside reflects the charge status. During discharging and charging an arrow drawn beside the symbol reflects the direction of the current flowing through the battery, pointing towards the battery during charging. Battery section is not present in DC-DC mode. |
| AUX | Auxiliary | The measured auxiliary output voltage and current is shown in this section. |

*Table 6 Symbols on screen*

For each section the icon background color reflects its status, green on healthy state or red/orange otherwise.

Furthermore, in case of alarm a message appears on the screen after 60 s of inactivity (no key pressed).



*Figure 12 UPS status screen*



*Figure 13 DC-DC status screen*



*Figure 14 Alarm screen*

## 6.2 Settings

The setting menu contains all the configurable parameters available to the user. Use the UP/DOWN key to navigate through the menu items. Press the OK key to enter and exit the editing mode, exiting the edit mode stores and activates the new configuration. While in editing mode use the UP/DOWN key to change the selected value. All settings are also accessible via Modbus at the specified address. All the battery related settings are ignored in DC-DC operating mode.

| 1 | Modbus address | |
|---|---|---|
| The Modbus slave address for the device. The same address is used for USB and RS485 connection. | | |
| **Default Value** | **Range** | **Resolution** |
| 1 | 1 … 247 | 1 |
| **Unit** | **LCD name** | **Modbus address** |
| N/A | Modbus address | 0x1000 |

| 2 | Modbus baud rate | |
|---|---|---|
| The baud rate for Modbus over RS485 serial port. | | |
| **Default Value** | **Values (Modbus value)** | |
| 38400 | 9600 (1), 19200 (2), 38400 (3), 57600 (4), 115200 (5) | |
| **Unit** | **LCD name** | **Modbus address** |
| N/A | Modbus baudrate | 0x1001 |

| 3 Modbus parity | | |
|---|---|---|
| The parity for Modbus over RS485 serial port. Available values are None, Even, Odd. | | |
| **Default Value** | **Values (Modbus value)** | |
| Even | None (1), Even (2), Odd (3) | |
| **Unit** | **LCD name** | **Modbus address** |
| N/A | Modbus parity | 0x1002 |

| 4 Modbus stop bits | | |
|---|---|---|
| The parity for Modbus over RS485 serial port. | | |
| **Default Value** | **Range** | **Resolution** |
| 1 | 1, 2 | 1 |
| **Unit** | **LCD name** | **Modbus address** |
| N/A | Modbus stop bits | 0x1003 |

| 5 Battery type | | |
|---|---|---|
| Defines the type of battery connected to the device. See section 5.1.3 for details about the different charging algorithms. | | |
| **Default Value** | **Values (Modbus value)** | |
| Pb | Lead (1), Nickel (2), Lithium (3), SuperCap (4) | |
| **Unit** | **LCD name** | **Modbus address** |
| N/A | Bat. type | 0x1010 |

| 6 Battery charge voltage | | |
|---|---|---|
| The maximum voltage applied to the battery while charging. See section 5.1.3 for details about the use of this parameter on the different charging algorithms. | | |
| **Default Value** | **Range** | **Resolution** |
| 10 V | 10 … 58 V | 0.1 V |
| **Unit** | **LCD name** | **Modbus address** |
| Volts | Bat. charge U | 0x1011 |

| 7 Battery charge current | | |
|---|---|---|
| The maximum current sourced to the battery while charging. See section 5.1.3 for details about the use of this parameter on the different charging algorithms. | | |
| **Default Value** | **Range** | **Resolution** |
| 0.5 A | 0.5 … 20 A | 0.1 A |
| **Unit** | **LCD name** | **Modbus address** |
| Amperes | Bat. charge I | 0x1012 |

| 8 Battery float voltage | | |
|---|---|---|
| The maximum voltage applied to the battery once it is fully charged. See section 5.1.3 for details about the use of this parameter on the different charging algorithms. | | |
| **Default Value** | **Range** | **Resolution** |
| 10 V | 10 … 58 V | 0.1 V |
| **Unit** | **LCD name** | **Modbus address** |
| Volts | Bat. Float U | 0x1013 |

| 9 Battery low voltage | | |
|---|---|---|
| Threshold for "Battery low" alarm (see no. 9 in section 6.4.2). | | |
| **Default Value** | **Range** | **Resolution** |
| 5 V | 5 … 58 V | 0.1 V |
| **Unit** | **LCD name** | **Modbus address** |
| Volts | Bat. low U | 0x1014 |

| 10 Battery deep discharge voltage | | |
|---|---|---|
| Threshold for the "Battery deep discharged" alarm (see no. 10 in section 6.4.2). | | |
| **Default Value** | **Range** | **Resolution** |
| 5 V | 5 … 58 V | 0.1 V |
| **Unit** | **LCD name** | **Modbus address** |
| Volts | Bat. deep disch. U | 0x1015 |

| 11 Battery max. discharge current | | |
|---|---|---|
| During backup the UPS module limits the maximum discharge current to this value reducing the output voltage if necessary. | | |
| **Default Value** | **Range** | **Resolution** |
| 21 A | 5 … 21 A | 0.1 A |
| **Unit** | **LCD name** | **Modbus address** |
| Amperes | Bat. max. disch. I | 0x1016 |

| 12 Battery capacity – Supercap capacitance | | |
|---|---|---|
| Nominal capacity (Ah) of the installed battery or capacitance (F) in case a Supercapacitor is installed. This parameter is used to calculate the battery State of Charge (SoC) during charge and discharge. | | |
| **Default Value** | **Range** | **Resolution** |
| 1 Ah or 1 F | 1 … 200 Ah or F | 0.1 Ah or F |
| **Unit** | **LCD name** | **Modbus address** |
| Ampere hours or Farad | Bat. capacity | 0x1017 |

| 13 Battery min. temperature | | |
|---|---|---|
| Threshold for the "Battery undertemperature" alarm (see no. 3 in section 6.4.2). | | |
| **Default Value** | **Range** | **Resolution** |
| -40 °C | -40 … 60 °C | 1 °C |
| **Unit** | **LCD name** | **Modbus address** |
| Degree Celsius | Bat. min. T | 0x1018 |

| 14 Battery max. temperature | | |
|---|---|---|
| Threshold for the "Battery over temperature" alarm (see no. 4 in section 6.4.2). | | |
| **Default Value** | **Range** | **Resolution** |
| 60 °C | -40 … 60 °C | 1 °C |
| **Unit** | **LCD name** | **Modbus address** |
| Degree Celsius | Bat. max. T | 0x1019 |

| 15  Battery lifetime | | |
|---|---|---|
| Threshold for the "Battery lifetime elapsed" alarm (see no. 5 in section 6.4.2). | | |
| **Default Value** | **Range** | **Resolution** |
| 100 kh | 1 … 100 kh | 1 kh |
| **Unit** | **LCD name** | **Modbus address** |
| Kilo hours | Bat. lifetime | 0x101A |

| 16  Ri alarm mode | |
|---|---|
| Mode of operation for the "Battery Ri too high" alarm (see no. 2 in section 6.4.2). | |
| **Default Value** | **Values (Modbus value)** |
| Disabled | Disabled (0), Fixed (1), Automatic (2), Auto. Done (3) |
| **Unit** | **LCD name** |
| N/A | Ri mode |

| 16  Ri alarm mode | | |
|---|---|---|
| **Unit** | **LCD name** | **Modbus address** |
| N/A | Ri mode | 0x101B |

| 17  Ri nom. | | |
|---|---|---|
| Used for the threshold calculation of the "Battery Ri too high" alarm (see no. 2 in section 6.4.2). | | |
| **Default Value** | **Range** | **Resolution** |
| 1 m© | 1 … 300 m© | 0.1 m© |
| **Unit** | **LCD name** | **Modbus address** |
| Milli Ohm | Ri nominal | 0x101C |

| 18  Ri max. variation | | |
|---|---|---|
| Used for the threshold calculation of the "Battery Ri too high" alarm (see no. 2 in section 6.4.2). | | |
| **Default Value** | **Range** | **Resolution** |
| 300% | 50 … 300% | 1% |
| **Unit** | **LCD name** | **Modbus address** |
| Percent | Ri max. variation | 0x101D |

| 19  Operating mode | | |
|---|---|---|
| Defines the UPS module's operating mode. See section 5.1 and 5.2 for details of each mode. | | |
| **Default Value** | **Values (Modbus value)** | |
| UPS | UPS (1), DC/DC (2) | |
| **Unit** | **LCD name** | **Modbus address** |
| N/A | Operating mode | 0x1020 |

| 20  Nominal output voltage | | |
|---|---|---|
| **UPS mode:** The UPS module enters backup mode when the output voltage drops below 90% of the nominal value. It is also the regulated output voltage during backup.<br>**DC-DC mode:** The UPS module corresponds to the regulated output voltage. | | |
| **Default Value** | **Range** | **Resolution** |
| 10 V | 10 … 58 V | 0.1 V |
| **Unit** | **LCD name** | **Modbus address** |
| Volts | Output nominal U | 0x1021 |

### 21  Max. input current

**UPS mode:** The UPS module limits the maximum input current to this value reducing the battery charging current if necessary.
**DC-DC mode:** The UPS module limits the maximum input current (in DC-DC mode the input is connected to the battery connection) to this value reducing the output voltage if necessary.

| Default Value | Range | Resolution |
|---|---|---|
| 20 A | 1 … 21 A | 0.1 A |
| **Unit** | **LCD name** | **Modbus address** |
| Amperes | Max input I | 0x1022 |

### 22  Max. output current

The UPS module limits the maximum output current to this value reducing the output voltage if necessary.

| Default Value | Range | Resolution |
|---|---|---|
| 20 A | 5 … 21 A | 0.1 A |
| **Unit** | **LCD name** | **Modbus address** |
| Amperes | Max output I | 0x1023 |

### 23  Max. Backup time enable

If enabled, the UPS module shuts down if the backup last more than the "Max. backup time" value (see no. 24 in section 6.2).

| Default Value | Values (Modbus value) | |
|---|---|---|
| Disabled | Disabled (0), Enabled (1) | |
| **Unit** | **LCD name** | **Modbus address** |
| N/A | Backup time enable | 0x1024 |

### 24  Max. backup time

If "Max. Backup time enable" field is enabled, the UPS module shuts down if the backup last more than the specified amount of time.

| Default Value | Range | Resolution |
|---|---|---|
| 1440 min | 1 … 1440 min | 1 min |
| **Unit** | **LCD name** | **Modbus address** |
| Minutes | Back. time max | 0x1025 |

### 25  Buzzer enable

Enable/Disable buzzer sound in case of alarm.

| Default Value | Values (Modbus value) | |
|---|---|---|
| Disabled | Disabled (0), Enabled (1) | |
| **Unit** | **LCD name** | **Modbus address** |
| N/A | Buzzer enable | 0x1026 |

<table>
<tr><td colspan="3"><strong>26 Relay 1 configuration</strong></td></tr>
<tr><td><strong>Default Value</strong></td><td colspan="2"><strong>Flags (bit)</strong></td></tr>
<tr><td>Normally open, Bat. life time, Bat. Ri too high, Bat. Charge failure</td><td colspan="2">Normally open (0), Backup (1), Soc <25% (2), Bat. life time (3), Bat. Ri too high (4), Bat. Low (5), Bat. Disconnected (6), Bat. charge failure (7), Backup left <25% (8)</td></tr>
<tr><td><strong>Unit</strong></td><td><strong>LCD name</strong></td><td><strong>Modbus address</strong></td></tr>
<tr><td>N/A</td><td>Relay 1</td><td>0x1027</td></tr>
<tr><td colspan="3">This field defines the behavior of relay 1 as follows:</td></tr>
</table>

| Normally open | 1 or more enabled state active? | Relay contact status |
|---|---|---|
| True | No | Open |
| True | Yes | Closed |
| False | No | Closed |
| False | Yes | Open |

<table>
<tr><td colspan="3"><strong>27 Relay 2 configuration</strong></td></tr>
<tr><td colspan="3">This field defines the behavior of relay 2 (see "Relay 1 configuration", no. 26 in section 6.2).</td></tr>
<tr><td><strong>Default Value</strong></td><td colspan="2"><strong>Flags (bit)</strong></td></tr>
<tr><td>Normally open, Backup</td><td colspan="2">Normally open (0), Backup (1), Soc < 25% (2), Bat. life time (3), Bat. Ri too high (4), Bat. Low (5), Bat. Disconnected (6), Bat. charge failure (7), Backup left < 25% (8)</td></tr>
<tr><td><strong>Unit</strong></td><td><strong>LCD name</strong></td><td><strong>Modbus address</strong></td></tr>
<tr><td>N/A</td><td>Relay 2</td><td>0x1028</td></tr>
</table>

<table>
<tr><td colspan="3"><strong>28 Inhibit polarity</strong></td></tr>
<tr><td colspan="3">Selects the active polarity of the inhibit input. See section 5.4 for more information about the inhibit function.</td></tr>
<tr><td><strong>Default Value</strong></td><td colspan="2"><strong>Values (Modbus value)</strong></td></tr>
<tr><td>High</td><td colspan="2">Low (1), High (2)</td></tr>
<tr><td><strong>Unit</strong></td><td><strong>LCD name</strong></td><td><strong>Modbus address</strong></td></tr>
<tr><td>N/A</td><td>Inhibit polarity</td><td>0x1029</td></tr>
</table>

<table>
<tr><td colspan="3"><strong>29 DC-DC output mode</strong></td></tr>
<tr><td colspan="3">Select parallel mode in case the UPS module is configure as DC-DC with output connected in parallel with another unit.</td></tr>
<tr><td><strong>Default Value</strong></td><td colspan="2"><strong>Values (Modbus value)</strong></td></tr>
<tr><td>Single</td><td colspan="2">Single (1), Parallel (2)</td></tr>
<tr><td><strong>Unit</strong></td><td><strong>LCD name</strong></td><td><strong>Modbus address</strong></td></tr>
<tr><td>N/A</td><td>DC/DC out mode</td><td>0x102A</td></tr>
</table>

<table>
<tr><td colspan="3"><strong>30 Output enable</strong></td></tr>
<tr><td colspan="3">Enable/Disable output.</td></tr>
<tr><td><strong>Default Value</strong></td><td colspan="2"><strong>Values (Modbus value)</strong></td></tr>
<tr><td>Enabled</td><td colspan="2">Disabled (0), Enabled (1)</td></tr>
<tr><td><strong>Unit</strong></td><td><strong>LCD name</strong></td><td><strong>Modbus address</strong></td></tr>
<tr><td>N/A</td><td>Output enable</td><td>0x102B</td></tr>
</table>

### 31 Aux enable

Enable/Disable auxiliary output.

| Default Value | Values (Modbus value) | |
|---|---|---|
| Enabled | Disabled (0), Enabled (1) | |
| **Unit** | **LCD name** | **Modbus address** |
| N/A | Aux enable | 0x102C |

### 32 Cold start on inhibit toggle

Enable/Disable the cold start on inhibit toggle. See section 5.1.6 for more details.

| Default Value | Values (Modbus value) | |
|---|---|---|
| Disabled | Disabled (0), Enabled (1) | |
| **Unit** | **LCD name** | **Modbus address** |
| N/A | CS on inhibit | 0x102D |

### 33 Cold start on battery connection

Enable/Disable the cold start on battery connection. See section 5.1.6 for more details.

| Default Value | Values (Modbus value) | |
|---|---|---|
| Disabled | Disabled (0), Enabled (1) | |
| **Unit** | **LCD name** | **Modbus address** |
| N/A | CS on battery | 0x102E |

### 34 PC shutdown enable

See section 5.1.5 for more details.

| Default Value | Values (Modbus value) | |
|---|---|---|
| Disabled | Disabled (0), Enabled (1) | |
| **Unit** | **LCD name** | **Modbus address** |
| N/A | PC shutdown enable | 0x1030 |

### 35 PC automatic restart enable

See section 5.1.5 for more details.

| Default Value | Values (Modbus value) | |
|---|---|---|
| Disabled | Disabled (0), Enabled (1) | |
| **Unit** | **LCD name** | **Modbus address** |
| N/A | PC restart enable | 0x1031 |

### 36 PC shutdown delay

See section 5.1.5 for more details.

| Default Value | Range | Resolution |
|---|---|---|
| 3600 s | 1 … 3600 s | 1 s |
| **Unit** | **LCD name** | **Modbus address** |
| Seconds | PC shutdown delay | 0x1032 |

### 37 PC shutdown time

| See section 5.1.5 for more details. | | |
|---|---|---|
| **Default Value** | **Range** | **Resolution** |
| 600 s | 1 … 600 s | 1 s |
| **Unit** | **LCD name** | **Modbus address** |
| Seconds | PC shutdown time | 0x1033 |

### 38 PC restart minimum time

| See section 5.1.5 for more details. | | |
|---|---|---|
| **Default Value** | **Range** | **Resolution** |
| 1 s | 1 … 60 s | 1 s |
| **Unit** | **LCD name** | **Modbus address** |
| Seconds | PC restart time | 0x1034 |

### 39 PC off detection current threshold

| See section 5.1.5 for more details. | | |
|---|---|---|
| **Default Value** | **Range** | **Resolution** |
| 0 A | 0 … 20 A | 0.1 A |
| **Unit** | **LCD name** | **Modbus address** |
| Amperes | PC OFF I | 0x1035 |

### 40 PC off detection timer

| See section 5.1.5 for more details. | | |
|---|---|---|
| **Default Value** | **Range** | **Resolution** |
| 1 s | 1 … 60 s | 1 s |
| **Unit** | **LCD name** | **Modbus address** |
| Seconds | PC OFF time | 0x1036 |

### 41 Blink output on backup enable

| See section 5.1.7 for more details. | | |
|---|---|---|
| **Default Value** | **Values** | |
| Disabled | Disabled (0), Enabled (1) | |
| **Unit** | **LCD name** | **Modbus address** |
| N/A | Blink out enable | 0x1040 |

### 42 Blink output on backup Ton

| See section 5.1.7 for more details. | | |
|---|---|---|
| **Default Value** | **Range** | **Resolution** |
| 10 s | 10 … 600 s | 1 s |
| **Unit** | **LCD name** | **Modbus address** |
| Seconds | Blink out Ton | 0x1041 |

| 43 Blink output on backup Toff | | |
|---|---|---|
| See section 5.1.7 for more details. | | |
| **Default Value** | **Range** | **Resolution** |
| 0.2 s | 0.1 … 60 s | 0.1 s |
| **Unit** | **LCD name** | **Modbus address** |
| Seconds | Blink out Toff | 0x1042 |

| 44 Output short circuit latch enable | | |
|---|---|---|
| When enable the device disables the output when a short circuit is detected on the output. To restart the output, the operator must press the OK button on the front panel. | | |
| **Default Value** | **Values** | |
| Disabled | Disabled (0), Enabled (1) | |
| **Unit** | **LCD name** | **Modbus address** |
| Seconds | Out SC latch enable | 0x1043 |

| 45 Output short circuit detection voltage threshold | | |
|---|---|---|
| See section 5.1.7 for more details. | | |
| **Default Value** | **Range** | **Resolution** |
| 3 V | 3 … 58 V | 0.1 V |
| **Unit** | **LCD name** | **Modbus address** |
| Volts | Out SC detection th. | 0x1044 |

| 46 High inrush load enable | | |
|---|---|---|
| When enabled and the output is switched on, the unit sends a higher current pulse to withstand loads with a high start-up inrush current. | | |
| **Default Value** | **Values** | |
| Disabled | Disabled (0), Enabled (1) | |
| **Unit** | **LCD name** | **Modbus address** |
| N/A | High inrush enable | 0x1045 |

| 47 Battery installation date | | |
|---|---|---|
| This field is used to compute the battery lifetime. If the battery lifetime exceeds the "Battery lifetime" value (see no. 15 in section 6.2), the "Battery lifetime elapsed" alarm activates (see no. 5 in section 6.4.2). | | |
| **Default Value** | **Range** | |
| 1st January 2000 | from 1st January 2000 to 31st December 2099 | |
| **Unit** | **LCD name** | **Modbus address** |
| N/A | Bat. installation date | 0x1100 |

| 48 Battery charge cycles | | |
|---|---|---|
| The value increments automatically at the end of a battery charge cycle. | | |
| **Default Value** | **Range** | **Resolution** |
| 0 | 0 … 65535 | 1 |
| **Unit** | **LCD name** | **Modbus address** |
| Cycles | Bat. charge cycles | 0x1104 |

## 6.3 Info menu

While in the info menu, use the UP/DOWN key to navigate through the menu items. The fields are also accessible via Modbus at the specified address. Modbus device identification fields are read using function 43/13 (0x2B/0x0E) at the specified object id.

| 1 | Firmware version | |
|---|---|---|
| 3.3 digit indicating the firmware major minor version | | |
| LCD name | | Modbus |
| FW version | | Device Identification Object Id 0x02 |

| 2 | Firmware subversion | |
|---|---|---|
| 3 digit indicating the firmware subversion. | | |
| LCD name | | Modbus |
| FW subversion | | Device Identification Object Id 0x80 |

| 3 | Build date | |
|---|---|---|
| Firmware build date. | | |
| LCD name | | Modbus |
| Build date | | Device Identification Object Id 0x82 |

| 4 | Build time | |
|---|---|---|
| Firmware build time. | | |
| LCD name | | Modbus |
| Build time | | Device Identification Object Id 0x83 |

| 5 | Serial number | |
|---|---|---|
| Device serial number. | | |
| LCD name | | Modbus |
| S/N | | Device Identification Object Id 0x81 |

| 6 | Boot cycles | |
|---|---|---|
| Counter of power ON cycles. | | |
| Unit | LCD name | Modbus address |
| Cycles | Boot cycles | 0x2010 |

| 7 | Operating time | |
|---|---|---|
| Counter for operating hours of the UPS module. | | |
| Unit | LCD name | Modbus address |
| Hours | Operating time | 0x2020 |

| 8 | Battery operating time | |
|---|---|---|
| Hours elapsed since the "Battery installation date" (see no. 41 in section 6.2). | | |
| Unit | LCD name | Modbus address |
| Hours | Bat. operating time | 0x2022 |

## 6.4 Logs

Every event is logged in the device flash memory. From the log menu the user can view their history. Use the UP/DOWN keys to navigate between logs, 2 logs are visible simultaneously on the LCD.
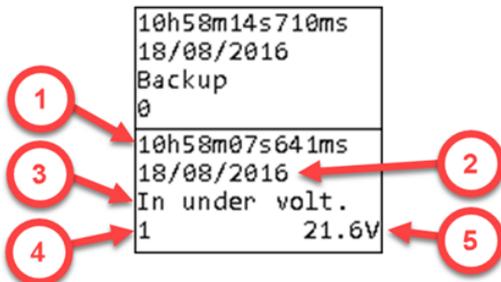


1. **Time:** time at which the log occurred
2. **Date:** date at which the log occurred
3. **Name:** unique log name
4. **Primary value:** optional, see below for details
5. **Secondary value:** optional, see below for details

*Figure 15 Log Screen*

Logs are of 3 different kinds: **info**, **alarms** and **events**. All info and alarms have an associated Modbus field representing the current status (0 if inactive or 1 if active). For info and alarms a log is generated at each status transaction. In case of active alarm, the front LED and the buzzer turn ON.

### 6.4.1 Info

| 1 | Battery charging | |
|---|---|---|
| Active when the battery is charging. | | |
| **LCD name** | | **Modbus address** |
| Bat charging | | 0x4000 |
| **Value 1** | | **Value 2** |
| Inactive (0), Active (1) | | Not used |

| 2 | Battery floating | |
|---|---|---|
| Active when the battery is fully charged. | | |
| **LCD name** | | **Modbus address** |
| Bat floating | | 0x4001 |
| **Value 1** | | **Value 2** |
| Inactive (0), Active (1) | | Not used |

| 3 | Battery discharging | |
|---|---|---|
| Active when the battery is discharging. | | |
| **LCD name** | | **Modbus address** |
| Bat. discharging | | 0x4002 |
| **Value 1** | | **Value 2** |
| Inactive (0), Active (1) | | Not used |

| 4 | USB powered | |
|---|---|---|
| The UPS module is powered by USB only. | | |
| **LCD name** | | **Modbus address** |
| USB powered | | 0x4020 |
| **Value 1** | | **Value 2** |
| Inactive (0), Active (1) | | Not used |

| 5 Cold start | |
|---|---|
| The UPS module has powered ON through cold start (see section 5.1.6). | |
| **LCD name** | **Modbus address** |
| Cold start | 0x4021 |
| **Value 1** | **Value 2** |
| Inactive (0), Active (1) | Not used |

| 6 PC shutdown | |
|---|---|
| Command to shutdowns the PC (see section 5.1.5). | |
| **LCD name** | **Modbus address** |
| PC shutdown | 0x4022 |
| **Value 1** | **Value 2** |
| Inactive (0), Active (1) | Not used |

| 7 PC power off | |
|---|---|
| Command to power OFF the PC (see section 5.1.5), the UPS module's output switches OFF. | |
| **LCD name** | **Modbus address** |
| PC power OFF | 0x4023 |
| **Value 1** | **Value 2** |
| Inactive (0), Active (1) | Not used |

| 8 External temperature sensor presence | |
|---|---|
| Active if the optional external temperature sensor is connected. | |
| **LCD name** | **Modbus address** |
| Ext. T sensor presence | 0x4024 |
| **Value 1** | **Value 2** |
| Inactive (0), Active (1) | Not used |

| 9 Inhibit | |
|---|---|
| Active if the inhibit input signal is asserted (see section 5.4). | |
| **LCD name** | **Modbus address** |
| Inhibit | 0x4025 |
| **Value 1** | **Value 2** |
| Inactive (0), Active (1) | Not used |

| 10 Output disabled | |
|---|---|
| Active if the output is disabled in settings. | |
| **LCD name** | **Modbus address** |
| Output disabled | 0x4026 |
| **Value 1** | **Value 2** |
| Inactive (0), Active (1) | Not used |

| 11 Auxiliary output disabled | |
|---|---|
| Active if the auxiliary output is disabled in settings. | |
| **LCD name** | **Modbus address** |
| Aux disabled | 0x4027 |
| **Value 1** | **Value 2** |
| Inactive (0), Active (1) | Not used |

## 6.4.2 Alarms

| 1 Battery disconnect | |
|---|---|
| Active when no battery is detected by the UPS module. | |
| **LCD name** | **Modbus address** |
| Bat. disconnected | 0x4010 |
| **Value 1** | **Value 2** |
| Inactive (0), Active (1) | Not used |

| 2 Battery Ri too high | |
|---|---|
| Active when measured battery internal resistance exceeds the alarm threshold (see section 5.1.2). | |
| **LCD name** | **Modbus address** |
| Bat. Ri too high | 0x4011 |
| **Value 1** | **Value 2** |
| Inactive (0), Active (1) | Status 0 → 1: Offending threshold<br>Status 1 → 0: Max. measured value |

| 3 Battery undertemperature | |
|---|---|
| Active when the battery measured temperature (using the optional external sensor) is under the threshold specified in "Battery min. temperature" field (see no. 13 in section 6.2). If active, the battery charged is disabled. | |
| **LCD name** | **Modbus address** |
| Bat. under temperature | 0x4012 |
| **Value 1** | **Value 2** |
| Inactive (0), Active (1) | Status 0 → 1: Offending threshold<br>Status 1 → 0: Min. measured value |

| 4 Battery overtemperature | |
|---|---|
| Active when the battery measured temperature (using the optional external sensor) exceeds the threshold specified in "Battery max. temperature" field (see no. 14 in section 6.2). If active, the battery charged is disabled. | |
| **LCD name** | **Modbus address** |
| Bat. over temperature | 0x4013 |
| **Value 1** | **Value 2** |
| Inactive (0), Active (1) | Status 0 → 1: Offending threshold<br>Status 1 → 0: Max. measured value |

| 5 | Battery lifetime elapsed | |
|---|---|---|
| Active when the actual calculated battery lifetime exceeds the threshold specified in "Battery lifetime" field (see no. 15 in section 6.2). | | |
| **LCD name** | **Modbus address** | |
| Bat. lifetime elapsed | 0x4014 | |
| **Value 1** | **Value 2** | |
| Inactive (0), Active (1) | Status 0 → 1: Offending threshold<br>Status 1 → 0: Max. calculated value | |

| 6 | Battery charge failure | |
|---|---|---|
| Active when the UPS module could not charge the battery correctly. When active, the battery charger is disabled. Disconnect the battery to reset the alarm. | | |
| **LCD name** | **Modbus address** | |
| Bat. charge fail | 0x4015 | |
| **Value 1** | **Value 2** | |
| Inactive (0), Active (1) | Not used | |

| 7 | Battery SoC <25% | |
|---|---|---|
| Active when the battery State of Charge is under 25% of the nominal full charge capacity. | | |
| **LCD name** | **Modbus address** | |
| Bat. SoC <25% | 0x4016 | |
| **Value 1** | **Value 2** | |
| Inactive (0), Active (1) | Not used | |

| 8 | Battery over discharge current | |
|---|---|---|
| Active when the measured battery discharge current reaches the threshold specified in "Battery max. discharge current" field (see no. 11 in section 6.2). | | |
| **LCD name** | **Modbus address** | |
| Bat. over discharge I | 0x4017 | |
| **Value 1** | **Value 2** | |
| Inactive (0), Active (1) | Status 0 → 1: Offending threshold<br>Status 1 → 0: Max. measured value | |

| 9 | Battery low | |
|---|---|---|
| Active when the measured battery voltage is under the threshold specified in "Battery low voltage" field (see no. 9 in section 6.2). | | |
| **LCD name** | **Modbus address** | |
| Bat. low | 0x4018 | |
| **Value 1** | **Value 2** | |
| Inactive (0), Active (1) | Status 0 → 1: Offending threshold<br>Status 1 → 0: Min. measured value | |

| 10 | Battery deep discharged | |
|---|---|---|
| Active when the battery measured voltage is under the threshold specified in "Battery deep discharge voltage" field (see no. 10 in section 6.2). | | |
| **LCD name** | **Modbus address** | |
| Bat. deep discharge | 0x4019 | |
| **Value 1** | **Value 2** | |
| Inactive (0), Active (1) | Status 0 → 1: Offending threshold<br>Status 1 → 0: Min. measured value | |

| 11 Backup | |
|---|---|
| Active when the system is in backup (see section 5.1.1). | |
| **LCD name** | **Modbus address** |
| Backup | 0x4030 |
| **Value 1** | **Value 2** |
| Inactive (0), Active (1) | Not used |

| 12 Input undervoltage | |
|---|---|
| Active when the measured input voltage is under 90% of the "Nominal output voltage" field (see no. 20 in section 6.2). | |
| **LCD name** | **Modbus address** |
| Input under voltage | 0x4031 |
| **Value 1** | **Value 2** |
| Inactive (0), Active (1) | Status 0 → 1: Offending threshold<br>Status 1 → 0: Min. measured value |

| 13 Input overvoltage | |
|---|---|
| Active when the measured input voltage exceeds 120% of the "Nominal output voltage" field (see no. 20 in section 6.2). | |
| **LCD name** | **Modbus address** |
| Input over voltage | 0x4032 |
| **Value 1** | **Value 2** |
| Inactive (0), Active (1) | Status 0 → 1: Offending threshold<br>Status 1 → 0: Max. measured value |

| 14 Output undervoltage | |
|---|---|
| Active when the measured output voltage is under 90% of the "Nominal output voltage" field (see no. 20 in section 6.2). | |
| **LCD name** | **Modbus address** |
| Output under voltage | 0x4033 |
| **Value 1** | **Value 2** |
| Inactive (0), Active (1) | Status 0 → 1: Offending threshold<br>Status 1 → 0: Min. measured value |

| 15 Output overvoltage | |
|---|---|
| Active when the measured output voltage exceeds 120% of the "Nominal output voltage" field (see no. 20 in section 6.2). | |
| **LCD name** | **Modbus address** |
| Output over voltage | 0x4034 |
| **Value 1** | **Value 2** |
| Inactive (0), Active (1) | Status 0 → 1: Offending threshold<br>Status 1 → 0: Max. measured value |

| 16 Output overload | |
|---|---|
| Active when the measured output current reaches the threshold specified in "Max. output current" field (see no. 22 in section 6.2). | |
| **LCD name** | **Modbus address** |
| Output overload | 0x4035 |
| **Value 1** | **Value 2** |
| Inactive (0), Active (1) | Not used |

| 17 Input overcurrent | |
|---|---|
| Active when the measured input current reaches the threshold specified in "Max. input current" field (see no. 21 in section 6.2). | |
| **LCD name** | **Modbus address** |
| Input over current | 0x4036 |
| **Value 1** | **Value 2** |
| Inactive (0), Active (1) | Not used |

| 18 Auxiliary output overload | |
|---|---|
| Active when an excessive load is detected on the auxiliary output. | |
| **LCD name** | **Modbus address** |
| Aux overload | 0x4037 |
| **Value 1** | **Value 2** |
| Inactive (0), Active (1) | Not used |

| 19 External temperature sensor error | |
|---|---|
| Active when the external temperature sensor is not connected while its use is mandatory like in NiMh battery charging. | |
| **LCD name** | **Modbus address** |
| Ext. T sensor error | 0x4038 |
| **Value 1** | **Value 2** |
| Inactive (0), Active (1) | Not used |

| 20 Backup time left <25% | |
|---|---|
| Active when the system is in backup and the maximal backup time is less than the "Max. backup time" field (see no. 24 in section 6.2). | |
| **LCD name** | **Modbus address** |
| Backup time left <25% | 0x4039 |
| **Value 1** | **Value 2** |
| Inactive (0), Active (1) | Not used |

| 21 Warning overtemperature | |
|---|---|
| Active when the internal temperature is high. If the temperature increases more, the device may switch OFF. | |
| **LCD name** | **Modbus address** |
| Warn. over temperature | 0x403A |
| **Value 1** | **Value 2** |
| Inactive (0), Active (1) | Not used |

| 22 Error overtemperature | |
|---|---|
| Active when the internal temperature is too high. To prevent damage the device switches OFF. | |
| **LCD name** | **Modbus address** |
| Error over temperature | 0x403B |
| **Value 1** | **Value 2** |
| Inactive (0), Active (1) | Not used |

### 6.4.3 Events

| 1 Power ON event | |
|---|---|
| Generated at every time when the UPS module is turned ON. | |
| **LCD name** | **Modbus address** |
| Power ON | 0xE000 |
| **Value 1** | **Value 2** |
| Power ON count | Not used |

| 2 Shutdown event | |
|---|---|
| Generated at every time when the UPS module is turned OFF. | |
| **LCD name** | **Modbus address** |
| Shutdown | 0xE001 |
| **Value 1** | **Value 2** |
| Shutdown count | Shutdown reason:<br>1 - Deep discharge<br>2 - Max. backup time elapsed<br>3 - Shutdown command<br>4 - Reset command<br>5 - Inhibit signal |

## 6.5 Wizard (system configuration)

The wizard assists the user during the UPS module configuration. It should be run once at commissioning.

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