

OPERATING MANUAL

HD32WSF.S12

Solar panel
power supply unit



EN
V1.5



Contents

1 Description 3

2 Technical specifications..... 4

3 Electrical connections..... 5

4 SDI-12 protocol 7

5 Maintenance 16

6 Safety instructions 16

7 Accessories ordering codes 17

1 Description

HD32WSF.S12 is a solar panel power supply unit including a 12 Vdc / 7.2 Ah lead-acid battery and a charge regulator.

The power supply output of the unit is the unregulated voltage of the internal battery (nominal 12 V).

The unit is equipped with a NTC temperature sensor for monitoring the internal temperature and controlling the battery charging.

The **SDI-12** interface allows monitoring the temperature and the voltage of the internal battery and the voltage of the solar panel.

IP 65 housing for outdoor.

The unit is supplied with cable glands at the bottom of the housing for connecting the solar panel, the power supply output and the SDI-12 interface.

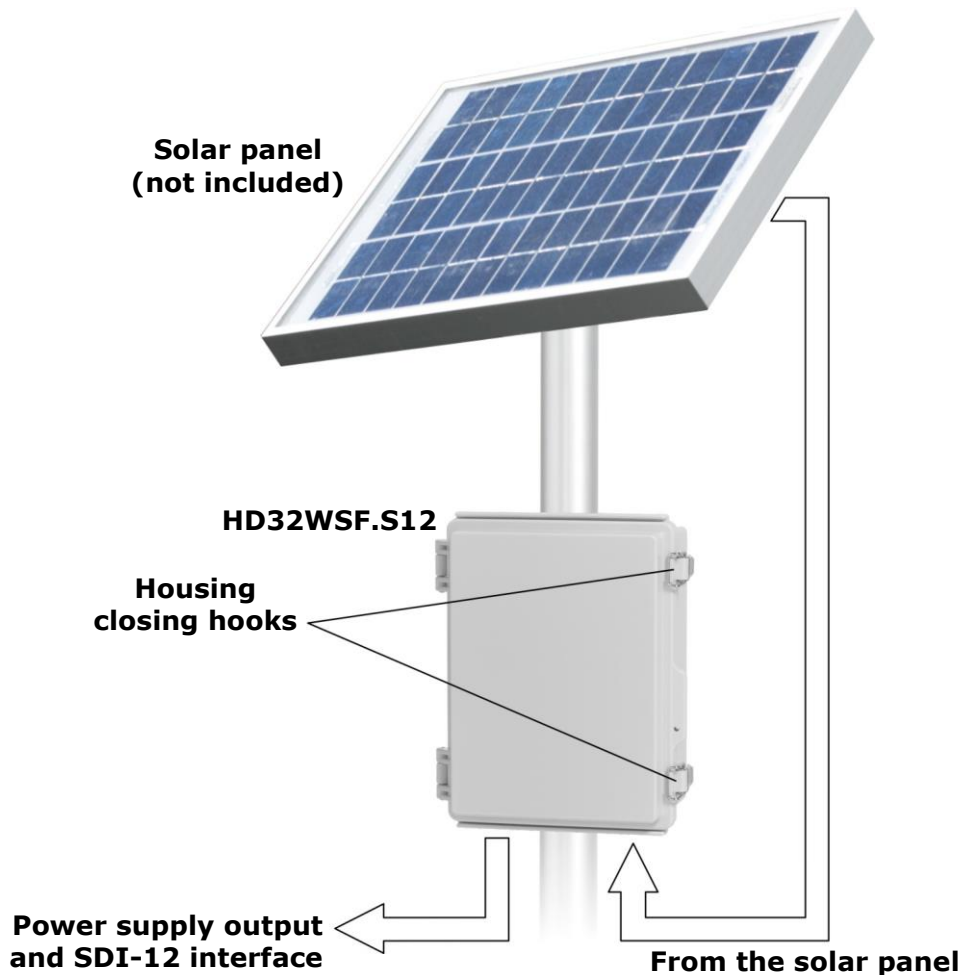


Fig. 1.1: HD32WSF.S12 power supply unit

2 Technical specifications

Input voltage	18...27 Vdc
Charging current limit	1 A typical
Output voltage	12 V unregulated from battery
Output current	1,6 A max.
Battery capacity	7.2 Ah
Battery type	Lead-acid
Operating temperature	-40...+60 °C
Digital interface	SDI-12
Dimensions	218 x 175 x 132 mm
Material	Polycarbonate
Protection degree	IP 65
Installation	Fixing to a max. 60 mm diameter mast.

3 Electrical connections

Open the housing of the power supply unit and connect the cables, through the cable glands at the bottom of the housing, to the terminals of the internal electronic board.

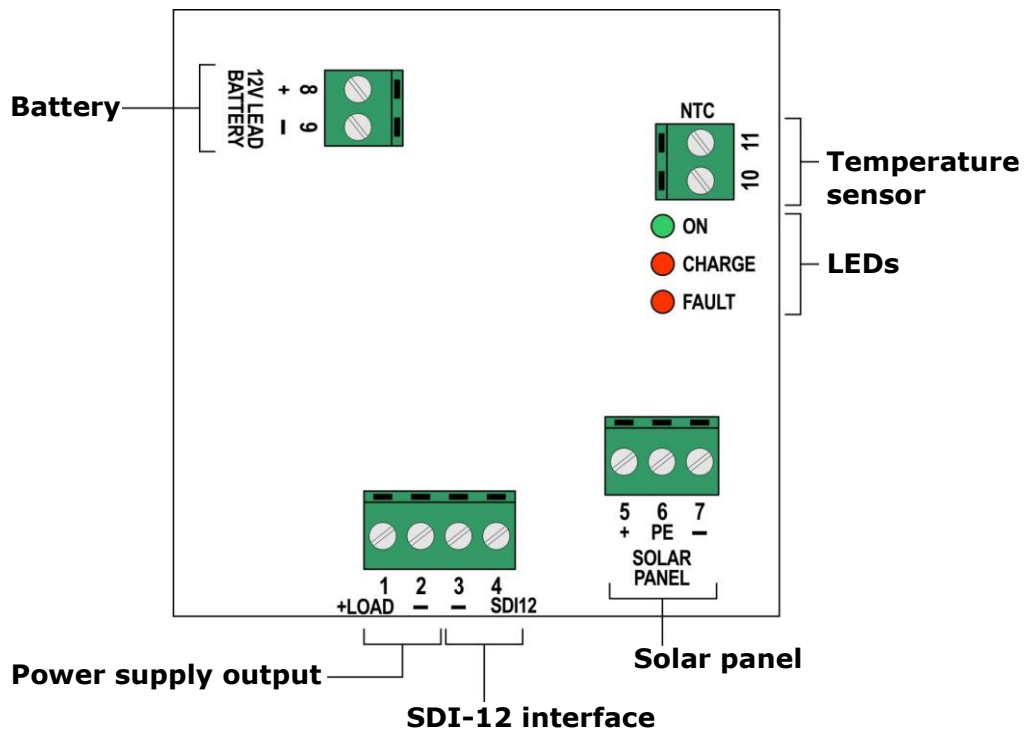


Fig. 3.1: internal electronic board

Terminal number	Description
1	Power supply output positive
2	GND (Power supply output and SDI-12 interface negative)
3	GND (Power supply output and SDI-12 interface negative)
4	SDI-12 line positive
5	Solar panel positive
6	Protective Earth (PE)
7	Solar panel negative
8	Battery positive
9	Battery negative
10	NTC temperature sensor
11	NTC temperature sensor

ON LED: indicates that the board is powered

CHARGE LED: indicates that the battery is charging

FAULT LED: if the FAULT LED is on and the CHARGE LED is off, the battery is not working (it does not charge); if the FAULT and CHARGE LEDs are both on, the battery is working but the charging process is temporarily suspended because the operating limits for recharging the battery have been exceeded (for example, the measured temperature is higher than the maximum temperature, by default 50 °C, or lower than the minimum temperature, by default -15 °C, allowed for recharging).

SDI-12 CONNECTION

More SDI-12 devices can be connected in parallel. The SDI-12 bus maximum length is 60 m. Before connecting the device to an SDI-12 network containing other devices, set the address by using the proper SDI-12 command.

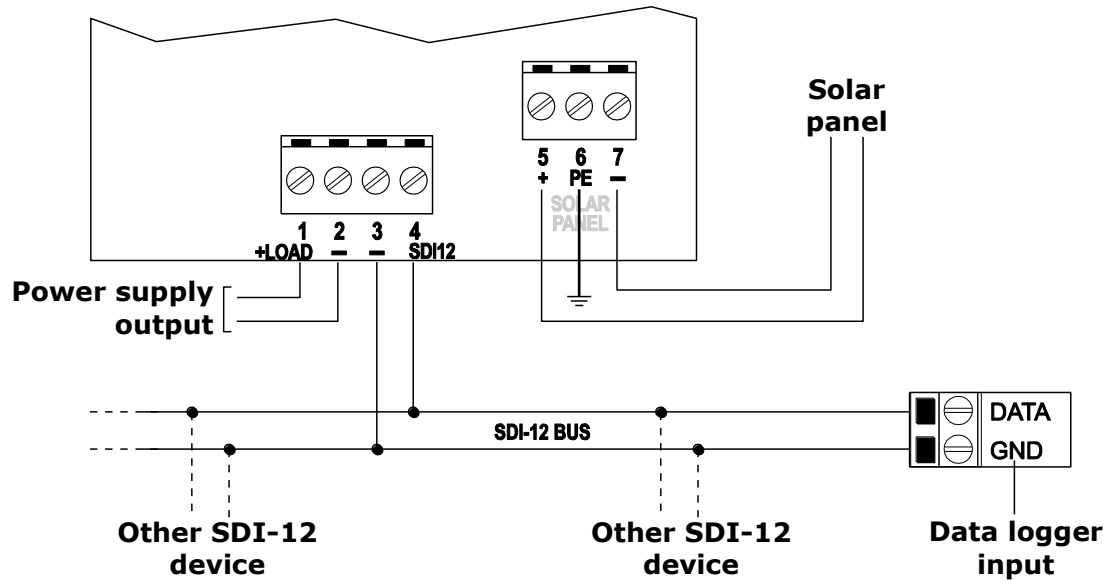


Fig. 3.2: SDI-12 connection

4 SDI-12 protocol

HD35WSF.S12 is compatible with version 1.3 of SDI-12 protocol.

The communication parameters are "1200, 7E1".

Communication with the unit is performed by sending a command in the following form:

<Address><Command>!

With <Address> = address of the unit the command is sent to
<Command> = type of operation requested to the unit

The unit reply is as follows:

<Address><Data><CR><LF>

With <Address> = address of the unit which replies
<Data> = information sent by the unit
<CR> = ASCII character *Carriage Return*
<LF> = ASCII character *Line Feed*

The available SDI-12 commands are shown below. For consistency with the documentation of the SDI-12 standard, the unit address is indicated with the letter **a**. The device leaves the factory with address preset to 0. The address can be changed by using the proper SDI-12 command.

SDI-12 commands

Command	Reply	Description
a!	a<CR><LF>	Checks for the presence of the unit.
aI!	allccccccmmmmmmvvvsssssss<CR><LF> with: a = address of the instrument (1 character) II = SDI-12 compliant version (2 characters) ccccccc = manufacturer (8 characters) mmmmm = instrument model (6 characters) vvv = firmware version (3 characters) sssssss = serial number (8 characters)	Requests for unit information.
aAb! Where: b =new address	b<CR><LF> Note: if the b character is not an acceptable address, the unit replies with a instead of b.	Change of unit address.
?!	a<CR><LF>	Request for unit address. If more than one device is connected to the bus, a conflict will occur.

Type M (start measurement) and C (start concurrent measurement) commands

Command	Reply	Description
Solar panel and battery voltage, temperature and system status		
aM! aC!	atttn<CR><LF> with: ttt = number of seconds necessary for the unit to make the data available (3 characters) n = number of detected variables (1 character for aM!, 2 characters for aC!) Note: ttt = 000 means datum immediately available.	Request to detect the solar panel voltage, the battery voltage, the temperature and the system status
aD0!	a+V _P +V _B +T+S <CR><LF> with: V _P = solar panel voltage in mV V _B = battery voltage in mV T = temperature in the set unit of measurement S = system status S=0 ⇒ battery not in charge S=1 ⇒ charging battery S=2 ⇒ battery not working S=3 ⇒ temperature outside the limits	Reads the solar panel voltage, the battery voltage, the temperature and the system status
Solar panel and battery maximum and minimum voltage in the current charging session		
aM1! aC1!	atttn<CR><LF> with: ttt = number of seconds necessary for the unit to make the data available (3 characters) n = number of detected variables (1 character for aM!, 2 characters for aC!) Note: ttt = 000 means datum immediately available.	Request to detect the solar panel and battery maximum and minimum voltage in the current charging session
aD0!	a+V _{Pmax} +V _{Pmin} +V _{Bmax} +V _{Bmin} <CR><LF> with: V _{Pmax} = maximum solar panel voltage in mV in the current charging session V _{Pmin} = minimum solar panel voltage in mV in the current charging session V _{Bmax} = maximum battery voltage in mV in the current charging session V _{Bmin} = minimum battery voltage in mV in the current charging session	Reads the solar panel and battery maximum and minimum voltage in the current charging session

Command	Reply	Description
Solar panel and battery maximum and minimum voltage in the last charging session		
aM2! aC2!	atttn<CR><LF> with: ttt = number of seconds necessary for the unit to make the data available (3 characters) n = number of detected variables (1 character for aM!, 2 characters for aC!) Note: ttt = 000 means datum immediately available.	Request to detect the solar panel and battery maximum and minimum voltage in the last charging session
aD0!	a+V _{Pmax} +V _{Pmin} +V _{Bmax} +V _{Bmin} <CR><LF> with: V _{Pmax} = maximum solar panel voltage in mV in the last charging session V _{Pmin} = minimum solar panel voltage in mV in the last charging session V _{Bmax} = maximum battery voltage in mV in the last charging session V _{Bmin} = minimum battery voltage in mV in the last charging session	Reads the solar panel and battery maximum and minimum voltage in the last charging session
Charge duration		
aM3! aC3!	atttn<CR><LF> with: ttt = number of seconds necessary for the unit to make the data available (3 characters) n = number of detected variables (1 character for aM!, 2 characters for aC!) Note: ttt = 000 means datum immediately available.	Request to detect the duration of the current and last charging sessions
aD0!	a+D _{CC} +D _{LC} <CR><LF> with: D _{CC} = duration of the current charging session in s D _{LC} = duration of the last charging session in s	Reads the duration of the current and last charging sessions
Temperature limits for charging the battery		
aM4! aC4!	atttn<CR><LF> with: ttt = number of seconds necessary for the unit to make the data available (3 characters) n = number of detected variables (1 character for aM!, 2 characters for aC!) Note: ttt = 000 means datum immediately available.	Request to detect the temperature limits for charging the battery
aD0!	a+T _{max} +T _{min} <CR><LF> with: T _{max} = maximum temperature, in the set unit of measurement, for charging the battery T _{min} = minimum temperature, in the set unit of measurement, for charging the battery	Reads the temperature limits for charging the battery

type R (continuous measurements) commands

Command	Reply	Description
aR0!	$a+V_P+V_B+T+S <CR><LF>$ with: V_P = solar panel voltage in mV V_B = battery voltage in mV T = temperature in the set unit of measurement S = system status $S=0 \Rightarrow$ battery not in charge $S=1 \Rightarrow$ charging battery $S=2 \Rightarrow$ battery not working $S=3 \Rightarrow$ temperature outside the limits	Reads the solar panel voltage, the battery voltage, the temperature and the system status
aR1!	$a+V_{Pmax}+V_{Pmin}+V_{Bmax}+V_{Bmin} <CR><LF>$ with: V_{Pmax} = maximum solar panel voltage in mV in the current charging session V_{Pmin} = minimum solar panel voltage in mV in the current charging session V_{Bmax} = maximum battery voltage in mV in the current charging session V_{Bmin} = minimum battery voltage in mV in the current charging session	Reads the solar panel and battery maximum and minimum voltage in the current charging session
aR2!	$a+V_{Pmax}+V_{Pmin}+V_{Bmax}+V_{Bmin} <CR><LF>$ with: V_{Pmax} = maximum solar panel voltage in mV in the last charging session V_{Pmin} = minimum solar panel voltage in mV in the last charging session V_{Bmax} = maximum battery voltage in mV in the last charging session V_{Bmin} = minimum battery voltage in mV in the last charging session	Reads the solar panel and battery maximum and minimum voltage in the last charging session
aR3!	$a+D_{CC}+D_{LC} <CR><LF>$ with: D_{CC} = duration of the current charging session in s D_{LC} = duration of the last charging session in s	Reads the duration of the current and last charging sessions
aR4!	$a+T_{max}+T_{min} <CR><LF>$ with: T_{max} = maximum temperature, in the set unit of measurement, for charging the battery T_{min} = minimum temperature, in the set unit of measurement, for charging the battery	Reads the temperature limits for charging the battery

In addition to the above commands, the pyranometer also implements the corresponding commands with CRC, that require to add a 3-character CRC code at the end of the reply.

Type X (extended commands) commands

The extended commands allows setting the conditions for charging the battery, as for example the minimum and maximum temperature to allow charging the battery, etc.

The charging parameters are already factory preset and optimized for the supplied battery. It is recommended not to change the parameters unless absolutely necessary. The modification of the parameters, if required, must be carried out by personnel with appropriate technical knowledge.

The editing of the operating parameters requires sending a password via the command **aXDPWDpassword!** (**a** is the address of the power supply unit). By default, the password is not set (the *password* field is blank); therefore, it is sufficient to send the command **aXDPWD!** without password to change the parameters. To protect the parameters from unauthorized changes, it is advisable to set a password with the command **aXDSUPpassword!**.

For example, to set °F as temperature unit of measurement in the device with address 0, send:

```
0XDPWDmypass!   Sends the password (assuming password=mypass)
0XDTUWF!         Sets °F
```

The password remains active for 10 minutes, after which you must resubmit it.

In the commands described below, the column "PWD" indicates whether the execution of the command is password protected.

Password

Command	Description	PWD
aXDPWDx...x!	Sends the password x...x (8 characters max.). Reply of the device: USER ACCESS OK if the password is accepted WRONG PASSWORD if the password is not accepted	---
aXDSUPx...x!	Sets the string x...x (8 ASCII characters max.) as password. Reply of the device: PASS: x...x if the password is accepted INVALID PASSWORD if the password is not accepted	Yes

Date and time

Command	Description	PWD
aXDDSyyyy/mm/dd hh:mm:ss!	Sets the date yyyy/mm/dd (year/month/day) and the time hh:mm:ss (hour/minutes/seconds) in the device. Reply of the device: & if date and time are accepted ? if date and time are not correct	Yes
aXDDG!	Reads the date (year/month/day) and the time (hour/minutes/seconds) set in the device. Reply of the device: yyyy/mm/dd hh:mm:ss	No

General info

Command	Description	PWD
aXDIR!	<p>Reads the manufacturer, the model, the firmware version and the serial number of the device.</p> <p>Reply of the device: <i>v...vm...mf...fs...s</i>, with:</p> <ul style="list-style-type: none"> <i>v...v</i> (8 characters) = name of the manufacturer <i>m...m</i> (6 characters) = model <i>f...f</i> (3 characters) = firmware version <i>s...s</i> (max. 13 characters) = serial number 	No

Unit of measurement

Command	Description	PWD
aXDTU<u>u</u>!	<p>Sets the temperature unit of measurement: <i>u</i>=C ⇒ °C, <i>u</i>=F ⇒ °F</p> <p>Factory setting: °C.</p> <p>Reply of the device:</p> <ul style="list-style-type: none"> & if the unit of measurement is accepted ? if the character <i>u</i> is not correct 	Yes
aXDTUR!	<p>Reads the unit of measurement of the temperature.</p> <p>Reply of the device:</p> <ul style="list-style-type: none"> C if the unit of measurement is "°C" F if the unit of measurement is "°F" 	No

Temperature and voltage limits for charging the battery

Command	Description	PWD
aXDWTU<i>n...n</i>!	<p>Sets <i>n...n</i> as maximum temperature for charging the battery: the battery is not charged if the measured internal temperature is higher than <i>n...n</i>.</p> <p>The value must be between +15.0 and +100.0 and is considered in the unit of measurement (°C o °F) set in the device.</p> <p>Factory setting: +50.0 °C.</p> <p>Example: 0XDWTU+40.0! sets +40 °C or +40 °F, depending on the unit of measurement set, as maximum temperature in the device with address 0.</p> <p>Reply of the device:</p> <ul style="list-style-type: none"> & if the value <i>n...n</i> is accepted ? if the value <i>n...n</i> is not correct 	Yes
aXDGTU!	<p>Reads the maximum temperature for charging the battery. The value is considered in the unit of measurement (°C or °F) set in the device.</p>	No
aXDWTL<i>n...n</i>!	<p>Sets <i>n...n</i> as minimum temperature for charging the battery: the battery is not charged if the measured internal temperature is lower than <i>n...n</i>.</p> <p>The value must be between -80.0 and +10.0 and is considered in the unit of measurement (°C o °F) set in the device.</p> <p>Factory setting: -20.0 °C.</p> <p>Example: 0XDWTL-5.0! sets -5 °C or -5 °F, depending on the unit of measurement set, as minimum temperature in the device with address 0.</p> <p>Reply of the device:</p> <ul style="list-style-type: none"> & if the value <i>n...n</i> is accepted ? if the value <i>n...n</i> is not correct 	Yes

Command	Description	PWD
aXDGT!	Reads the minimum temperature for charging the battery. The value is considered in the unit of measurement (°C or °F) set in the device.	No
aXDWVLn...n!	Sets <i>n...n</i> as minimum voltage in mV for charging the battery at low temperature: the battery is not charged if it has voltage lower than <i>n...n</i> and the measured internal temperature is lower than the value set with the command aXDWTVL...! . The value must be between 3000 and 15000 mV. Factory setting: 10500 mV (10.5 V). Example: 0XDWVL+10000! sets 10 V as minimum voltage in the device with address 0. Reply of the device: & if the value <i>n...n</i> is accepted ? if the value <i>n...n</i> is not correct	Yes
aXDGV!	Reads the minimum voltage in mV for charging the battery at low temperature (lower than the value set with the command aXDWTVL...!).	No
aXDWTVLn...n!	Sets <i>n...n</i> as temperature below which the battery is not charged if it has voltage lower than the value set with the command aXDWVL...! . The value must be between -80.0 and +10.0 and is considered in the unit of measurement (°C or °F) set in the device. Factory setting: -15.0 °C. Example: 0XDWTVL-10.0! sets -10 °C or -10 °F, depending on the unit of measurement set, as minimum temperature in the device with address 0. Reply of the device: & if the value <i>n...n</i> is accepted ? if the value <i>n...n</i> is not correct	Yes
aXDGTVL!	Reads the temperature below which the battery is not charged if it has voltage lower than the value set with the command aXDWVL...! .	No

Note on the minimum temperatures for charging the battery: the command **aXDWTLn...n!** sets the temperature below which the battery is never charged, while the command **aXDWTVLn...n!** sets the temperature below which the battery is not charged only if it has voltage lower than a certain value (defined with the command **aXDWVLn...n!**).

Enabling/disabling the battery charging

By default, the battery is charged as a function of the temperature and voltage limits set with the commands **aXDWTU...!**, **aXDWTL...!**, **aXDWVL...!** e **aXDWTVL...!**. The battery charging can be made independent from these limits, or permanently disabled.

Command	Description	PWD
aXDFCAS!	Enables the battery charging regardless of the limits set with the commands aXDWTU...! , aXDWTL...! , aXDWVL...! and aXDWTVL...! . Reply of the device: & <i>Note:</i> enabling the charging is effective only if not explicitly disabled with the command aXDFCSS! .	Yes

Command	Description	PWD
aXDFCAR!	Cancels the command aXDFCAS! and re-enable the battery charging as a function of the temperature and voltage limits set with the commands aXDWTU...!, aXDWTL...!, aXDWVL...! e aXDWTVL...!.	Yes
aXDFCAS!	Permanently disables the battery charging. Reply of the device: &	Yes
aXDFCSR!	Cancels the command aXDFCSS! and re-enable the battery charging.	Yes
aXDGFC!	Reads the enable status of the battery charging. Reply of the device: +a+b a=0, b=0 ⇒ charging as a function of the set limits is enabled (default) a=1, b=0 ⇒ charging regardless of the set limits is enabled a=0, b=1 ⇒ charging is disabled a=1, b=1 ⇒ charging is disabled (the command aXDFCSS! prevails)	No

Charging in case of dead battery

If the system detects that the battery is dead (it does not charge), the charging process is definitively stopped after a certain number of attempts (by default 5). The number of charging attempts before the final stop is configurable.

Command	Description	PWD
aXDAREE!	Enables the recharging attempts in case of dead battery. Reply of the device: &	Yes
aXDARED!	Disables the recharging attempts in case of dead battery. Reply of the device: &	Yes
aXDRARE!	Reads the enable status of the recharging attempts in case of dead battery. Reply of the device: +r r=0 ⇒ recharging attempts disabled (default) r=1 ⇒ recharging attempts enabled	No
aXDWARNn!	Sets n recharging attempts in case of dead battery. If n=0, the number of attempts is unlimited (and not zero attempts). Factory setting: 5. Reply of the device: &	Yes
aXDRARN!	Reads the number of recharging attempts in case of dead battery.	No
aXDRARA!	Reads the number of recharging attempts made until now.	No
aXDARAR!	Resets the number of recharging attempts made until now. Reply of the device: &	Yes

Status

Command	Description	PWD
aXDGSCF!	Reads the device operating status. Reply of the device: $+s+c+f$ $s=0 \Rightarrow$ LED ON is off $s=1 \Rightarrow$ LED ON is on $c=0 \Rightarrow$ LED CHARGE is off $c=1 \Rightarrow$ LED CHARGE is on $f=0 \Rightarrow$ LED FAULT is off $f=1 \Rightarrow$ LED FAULT is on	No

Reset

Command	Description	PWD
aXDHRS!	Resets the electronic board.	Yes

For more information about the protocol, visit the website "www.sdi-12.org".

5 Maintenance

Do not use aggressive cleaning agents or incompatible with the materials indicated in the technical specifications. For cleaning, use a soft dry cloth or slightly dampened with clean water.

6 Safety instructions

The instrument proper operation and operating safety can be ensured only in the climatic conditions specified in this manual and if all standard safety measures as well as the specific measures described in this manual are followed.

Do not use the instruments in places where there are:

- Corrosive or flammable gases.
- Direct vibrations or shocks to the instrument.
- High-intensity electromagnetic fields, static electricity.

User obligations

The instrument operator shall follow the directives and regulations below that refer to the treatment of dangerous materials:

- EU directives on workplace safety.
- National law regulations on workplace safety.
- Accident prevention regulations.

7 Accessories ordering codes

The unit is supplied with 12 Vdc / 7.2 Ah lead-acid battery, charge regulator and fixing accessories to a max. 60 mm diameter mast.

The solar panel must be ordered separately.

Accessories

OPZ30W Kit including 30 W PV Panel with support for mast and 2 m connecting cable.

NOTES

WARRANTY

The manufacturer is required to respond to the "factory warranty" only in those cases provided by Legislative Decree 6 September 2005 - n. 206. Each instrument is sold after rigorous inspections; if any manufacturing defect is found, it is necessary to contact the distributor where the instrument was purchased from. During the warranty period (24 months from the date of invoice) any manufacturing defects found will be repaired free of charge. Misuse, wear, neglect, lack or inefficient maintenance as well as theft and damage during transport are excluded. Warranty does not apply if changes, tampering or unauthorized repairs are made on the product. Solutions, probes, electrodes and microphones are not guaranteed as the improper use, even for a few minutes, may cause irreparable damages.

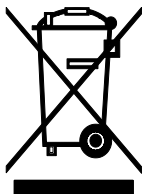
The manufacturer repairs the products that show defects of construction in accordance with the terms and conditions of warranty included in the manual of the product. For any dispute, the competent court is the Court of Padua. The Italian law and the "Convention on Contracts for the International Sales of Goods" apply.

TECHNICAL INFORMATION

The quality level of our instruments is the result of the continuous product development. This may lead to differences between the information reported in the manual and the instrument you have purchased.

We reserve the right to change technical specifications and dimensions to fit the product requirements without prior notice.

DISPOSAL INFORMATION



Electrical and electronic equipment marked with specific symbol in compliance with 2012/19/EU Directive must be disposed of separately from household waste. European users can hand them over to the dealer or to the manufacturer when purchasing a new electrical and electronic equipment, or to a WEEE collection point designated by local authorities. Illegal disposal is punished by law.

Disposing of electrical and electronic equipment separately from normal waste helps to preserve natural resources and allows materials to be recycled in an environmentally friendly way without risks to human health.



senseca.com



Senseca Italy S.r.l.
Via Marconi, 5
35030 Selvazzano Dentro (PD)
ITALY
info@senseca.com

