PHOTOVOLTAIC CHARGE CONTROLLER

RSD80 v3

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Specifically for controllers version 3.0x

1.- DESCRIPTION

The **SOLÉNER RSD80** battery charge controller has been designed and manufactured by **SOLUCIONES ENERGÉTICAS, S.A.** to regulate battery charging in standalone photovoltaic installations. Its reliability, versatility and ease of use make it an ideal piece of equipment for medium-sized domestic systems, while its remote signaling and communication ability make it the best for professional systems. It is compact and easily installed.

It includes an intelligent input diode to prevent reverse current flow from the battery to the solar modules at night time, while maintaining low power loss in normal mode.

2.- INSTALLATION

When connecting the battery, it is advisable to pay attention to the polarity. The controller itself is protected, but if the battery is connected with the polarity reversed it might cause damage to the loads (and in extreme cases to the output stage). **It is important to follow this connection sequence during connection:**

1. Connect the battery
2. Connect the photovoltaic modules
3. Connect the loads

For disconnection, the reverse order must be followed.

Tighten the terminals well (using a 13 mm **socket** wrench). If it is not well tightened the flow of the current will overheat the terminals, burning the contact. Retighten after two to three days (over time, copper yields slightly).

Although the controller is protected against battery disconnection, it is recommended that you do not remove it when the modules are charging as this can damage the consumption through a surge (overvoltage).

The initial charge stage is the equalization stage. It is repeated whenever the controller cuts out due to low battery or is restarted by the user. In gel batteries this stage does not exist. The equalization time can be adjusted using parameter O_{03}, see section 11.

The temperature probe (a cable that connects to the lower left-hand side) should be left hanging. Its purpose is to read the ambient temperature underneath the charge controller.

The functions of the connector are described in section 10.

3.- VISUAL INFORMATION

3.1.- SCREEN

The screen is of a large size, has excellent readability and offers a wealth of information about the status of the photovoltaic system. It turns off automatically when no key is pressed during O_{01} seconds. It is initially programmed for 900 seconds, and setting it to 0 means the screen is always on (this is not recommended).

The information shown changes automatically (see parameter O_{00}), but it can be changed using the keys ←↑↓ or paused temporarily with the key →. Any of five languages can be selected: Spanish, English, French, Portuguese and Russian.

The information that appears on the screen is:

- Serial number and version of the program installed.
- Manufacturer's data and contact information.
- Battery voltage and battery type selected.
- System status and charging stage.
- Remaining time for equalization stage (if equalizing).
- Ambient temperature and historical minimum/maximum.
- Load and consumption current and power.
- Load and consumption peaks since the last system reset.
- Energy charged and consumed since the last system reset.
- Date and time.
- 4-20 mA input reading.
- 0-10 V input readings An_1 and An_2
- Status of the relays
- Energy charged and consumed in the last seven days

3.2.- STATUS INDICATORS

The two LED on the left-hand side indicate the status of the controller:

- The yellow LED indicates, through the number of flashes, the charging stage of the controller: One flash indicates **Float** stage; two flashes **Absorption** stage and three flashes **Equalization** stage. The LED remains 'off' while the controller is recovering from a short-circuit and 'on' when there is a high voltage warning or a power switch is shut off.

- The red LED light turns on when there is a problem that implies disconnection of a power stage (overcurrent, short-circuit, high temperature or overvoltage). In these cases the controller will try to reactivate the power switch when the problem has been resolved or a reasonable period of time has passed (in the event of an overcurrent).

3.3.- BATTERY INDICATORS

The three LED on the right-hand side (similar to a traffic light), indicate the battery status:

- The red LED flashes when the battery voltage is low. It remains on when the voltage is lower than the disconnection voltage (recommended by the battery manufacturer) for more than 4 seconds, causing the shutdown of the output and the start of the equalization stage. Consumption will be automatically re-enabled when the battery reaches the reconnection voltage.

- The yellow LED flashes when the battery is half charged.

- The green LED flashes when the battery is nearly fully charged. It stays on when the controller disconnects the input switch because the battery is fully charged.

The beep sound and visual low battery alarm warn that consumption disconnection will shortly take place. The user should reduce consumption to extend the autonomy with the remaining battery charge. You can disable the audio alarm using O_{02}.

An abnormally high battery voltage indicates that there is a problem in the installation (battery has no electrolyte, bridges in poor condition, loose connections…). Please immediately inform the installation technician if this occurs.

3.4.- RELAY INDICATORS

Each of the remote signaling relays has an associated blue LED, which lights up when the relay is activated. These LEDs are located next to the eight-terminal connector that leads to the relay contacts, located on the right side of the controller.

4.- SETUP

Pressing the central button gives access to the setup menu. This menu allows the user to change the language, set the clock, start or stop the generator, start or stop the equalization stage, access the service menu or input maintenance commands.

The service menu is password-protected (default is 0000). If you change it, write it down as otherwise you will not be able to access the menu again.

My password

The maintenance menu is designed to change internal parameters that are not normally accessible. These codes are created and supplied by our technical department depending on the system that has been installed. WARNING: Introducing phony codes can irreparably damage the controller. For example, code CD417383 activates the beacon function on the consumption output and code C7414383 deactivates this function.

If you change a parameter the change will not take effect until you press the central key; if you exit using the ← key (or if you don't press any key for a while) the change will be undone.

When setting the time it is a good idea to use solar time (in Spain this is one hour earlier in wintertime and two hours earlier in summertime). This saves having to change it twice a year and is better for solar applications.

If you change the language and can't find the option to switch it back to english, just wait until the screen starts changing automatically, press the central key twice, the ↓ key once and then the central key once.

The Generator and Equalization options allow the user to start and stop the respective functions manually; if they are active they will stop and viceversa. Before carrying out either of these actions the user will be prompted to confirm that they wish to proceed. Note: a gel battery cannot be equalized.

The service menu allows the user to change the password and modify parameters of the battery, the relays, the generator or others, identified by B, R, G and O. See section 11 for more information.

You can also restart the controller (all partial counters and peaks will be cleared) and restore the factory values of the parameters. This does not affect the language, the counters, the time or the password.

5.- COMMUNICATIONS

The controller has a mini USB connector that will allow you to connect it to a computer; when doing so, it will appear as a Virtual Serial Port (the controller must be connected to a power supply during the process). WARNING: the chassis of the connector is connected to the negative terminal of the battery.

Linux systems with kernel 3.0.0 or higher do not need a driver; for other systems the driver must be installed prior to connecting the controller to the computer. You can download the driver from our web site (http://www.solener.com/descargas.html), available for Windows, OSX and Android.

On demand we can install a real serial port (RS-232 with DB9 connector and DCE connection) to connect the controller to a modem, a computer or a PLC.

The default connection parameters for both are 9600 bauds, 8 data bits, no parity, one stop bit and RTS/CTS flow control. The speed and parity of the RS-232 can be changed using O05 and O06. This port also supports MODBUS RTU (settable using O08) depending on the setting of O07.

The communication protocol uses text commands ending with an ASCII Line Feed (0x0A) character. You can connect manually using the terminal program included with your operating system or PuTTY, which is multiplatform freeware. The protocol, MODBUS addresses and sample C source code (for Windows) are available in the link provided above.

6.- OUTPUTS

6.1.- RELAYS

The function of the relays may be changed using parameters R_{00} to R_{03} and a value chosen from the following chart:

Code	Function	Parameters	Assigned to
0	Generator contact[1]	B_{09}	RL_1
2	Beacon, activates at night		
4	Low voltage alarm	B_{09}	
6	High voltage alarm	B_{01}	
8	Activates when the battery is charged (floating charge stage)	B_{04}	
10	Input I_{4-20} in range[2]	R_{04}, R_{05}	
12	Input An_1 in range[2]	R_{06}, R_{07}	
14	Input An_2 in range[2]	R_{08}, R_{09}	
16	Overheating		
18	Always active		
20	Timer 1 in range[4]	R_{10}, R_{11}, R_{12}	
22	Timer 2 in range[4]	R_{13}, R_{14}, R_{15}	
24	Timer 3 in range[4]	R_{16}, R_{17}, R_{18}	
26	Timer 4 in range[4]	R_{19}, R_{20}, R_21	
28	Battery temperature in range[2]	R_{22}, R_{23}	
30	Generator heater[1]	G_{01}	RL_2
32	Generator crank[1]	G_{02}	RL_3
34	Generator consumption connection[1]	G_{05}	RL_4
36	Generator start warning[1]	G_{00}	
38	Battery voltage in range[2]	R_{24}, R_{25}	
40	Battery voltage in range[3]	R_{24}, R_{25}	
42	Input I_{4-20} in range[3]	R_{04}, R_{05}	
44	Input An_1 in range[3]	R_{06}, R_{07}	
46	Input An_2 in range[3]	R_{08}, R_{09}	
48	Battery temperature in range[3]	R_{22}, R_{23}	

1: see how the generator works in section 7
2: activates when the value is >= than the higher threshold and deactivates when is <= than the lower threshold
3: activates when the value is between the lower and higher thresholds (both included)
4: activates when the current time is between the start and the end time (both included) on the selected days

To obtain the opposite function you must add 1 to the code. For example, if code 8 makes the relay activate when the battery is charged, then code 9 makes the relay deactivate.

6.1.- ANALOG OUTPUT

The analog output A_{out} allows the connecting of frequency inverters or analog indicators (mechanical voltmeters); it is protected against a shortcircuit to ground. You can select the function using parameter O_{04} and a code from the following table:

Code	Function
0	Proportional to input current (5 V = 80 A)
2	Proportional to output current (5 V = 80 A)
4	Proportional to output current minus input current (0 V = -80 A, 2.5 V = 0 A, 5 V = 80 A)
6	Proportional to battery voltage between low voltage disconnection and gassing, 2.5 V if they are equal
8	Second of the minute (0 V = 0 seconds, 5 V = 59 seconds)
10	Minute of the hour (0 V = 0 minutes, 5 V = 59 minutes)
12	Hour of the day (0 V = 0 hours, 5 V = 23 hours)
14	Minute of the day (0 V = 0 minutes, 5 V = 1439 minutes)
16	Day of the week (0 V = Sunday, 5 V = Saturday)
18	Day of the month (0 V = 0 days, 5 V = 30 days)
20	Day of the year (0 V = 0 days, 5 V = 365 days)
22	An_1 input (0 V = 0 V, 5 V = 10 V)
24	An_2 input (0 V = 0 V, 5 V = 10 V)
26	4 to 20 mA input (0 V = 0 mA, 5 V = 25 mA)
28	4 to 20 mA input (0 V = 4 mA, 5 V = 20 mA)
30	Proportional to battery voltage between R24 and R25, 2.5 V if they are equal
32	Always 5 V

The default value is 0. To get the inverse function add 1 to the code; for example, if code 2 makes the output go higher when the output current increases, then code 3 makes the output reduce with the current.

Time-related parameters generate a saw-tooth format signal that can be used for cyclical functions. If you connect a frequency inverter you can get variable duty cycles.

7.- GENERATOR

The generator starts automatically when the low voltage alarm is activated, and stops when the floating charge stage is reached. You can also start the generator manually using the menu or remotely using the serial ports or the analog inputs. Using parameter G_{11} you can set An_1 for starting and An_2 for stopping. If both are activated, An_2 prevails. Both signals are active with 5 volts or more. The usual functions of both inputs are not affected.

These are the steps when starting the generator:

- G_{00} seconds pause. The warning is activated (function 36), and it should be connected to a buzzer or warning light for security.
- The contact is activated (function 0).
- The heaters are powered (function 30) for G_{01} seconds and then cut out.
- Start attempt (up to G_{04} retries); a start attempt consists of G_{02} seconds of start up (function 32) followed by a G_{03} seconds pause. If all attempts fail the stop procedure is activated. The controller detects the start up when terminals CN3.1 and CN3.3 are connected, see G_{10}.
- G_{05} seconds pause to warm up the motor.
- Load connection (function 34).

The generator will run until:

- It is stopped manually using the menu.
- The battery reachs the floating charge stage.
- The battery reachs the voltage indicated in G_{09}.
- The time set in G08 elapses (0 = unlimited).

The stop procedure consists of the following steps:

- Load disconnection (function 34).
- G_{06} seconds pause for motor cooling and turbo lubrication.
- Contact disconnection (function 0).
- A timer is started so the generator won't restart automatically for G_{07} seconds.

8.- BATTERIES

	OPzS	OPzV	Traction	SOpzS	Gel	$LiFePO_4$
High Voltage Warning	2,625	2,583	2,625	2,650	2,542	2,450
Equalization Band	2,450/2,500	2,433/2,467	2,450/2,500	2,330/2,400	-	-
Deep Charge	2,450	2,400	2,400	2,600	2,450	2,433
Floating Band	2,300/2,400	2,283/2,317	2,300/2,400	2,250/2,300	2,300/2,400	2,417/2,433
Deep Recharge	2,103	2,083	2,103	2,103	2,103	2,400
Low Voltage Warning	1,853	1,833	1,875	1,875	1,853	1,700
Disconnection	1,833	1,792	1,853	1,850	1,833	1,667
Reconnection	2,167	2,167	2,167	2,167	2,167	2,133

The User Defined battery default values are those from OpzS

- The voltages listed above are in volts per element, if the system operates at 12 V you have to multiply them by six; if it is a 24 V system multiply them by twelve, and if it is a 48 V system multiply them by twenty four.

- These voltages are for 25 ºC. The charge controller is temperature compensated, so the actual voltage can be different.

- The LiFePO4 battery is available from version 3.03 onwards, while the SOPzS is available from version 3.04.

- You need the battery's manufacturer data in order to select the most similar battery. You can set up your own battery (at your own risk) using the Battery menu. The voltages are expressed in volts per element, and the temperature coefficient in mV/(V·ºC). The voltages are restricted, so (for example) the deep charge voltage can't be lower than the floating voltage. You can see all battery-related parameters and the restrictions on page 16.

9.- FEATURES

9.1.- Physical

Length × Width × Height	245 × 140 × 60 mm
Weight	1,65 kg
Casing	Galvanized steel
Paint	Furnace-painted epoxy
Protection Rating	IP32
Operating Range	-10 to 50 ºC
Terminals	8 mm screws with 13 mm nuts

9.2.- Electrical

Nominal Voltage	12/24 V_{dc}		48 V_{dc}
Battery Voltage Range	10-18	20-36	40-72 V_{dc}
Open Circuit Voltage (V_{oc})	50 V_{dc}	60 V_{dc}	105 V_{dc}
Number of cells in series	36 to 40	72 to 80	144 to 160
Maximum current during charge/discharge	80/80 A		
Analog Inputs (An_1 and An_2)	0 to 10 V_{dc}, R_{in} = 100 kΩ		
Current Input (I_{4-20})	0 to 27 mA, V_{oc} = 9 V		
Analog output (A_{out})	0 to 5 V, R_{out} = 10 Ω		
Autoconsumption	70/39 mA		21 mA
Maximum charge/discharge loss	20/5 W		34/15 W
Relay contacts (resistive load)	1 A at 30 V_{dc}, 0.5 A at 125 V_{ac}		

9.3.- General

Smart Blocking Diode	Yes
Temperature Compensated	Yes
Control	Series
Communications	USB serial (RS232 optional)
Protocol	ASCII commands, MODBUS RTU
Remote Signals	Four dry contacts
Real Time Clock	Yes, with 3-days battery backup
Display Viewing Angle	160º horizontal and vertical
Contrast	2000:1

These features may be modified without previous notification. The real time clock has a special rechargeable battery that does not require maintenance but only maintains the hour for a few days.

10.- Connectors

The connector terminals start from the upper part of the controller. The left-hand side connectors from top to bottom are:

Terminal	Function
CN1.1	Positive of 4 to 20 mA connection loop.
CN1.2	Negative of 4 to 20 mA connection loop.

Terminal	Function
CN2.1	0 to 10 V (An_1) input
CN2.2	0 to 10 V (An_2) input
CN2.3	Common (connected to battery negative)

Terminal	Function
CN3.1	Must be connected to terminal 3 when the generator starts up
CN3.2	Not connected
CN3.3	Battery positive (output)
CN3.4	Analog output 0 to 5 V (Aout), see parameter O04
CN3.5	Common (connected to battery negative)

The temperature probe connector, located at the bottom, is different from the others. The USB connector is located at the right-hand side, and beneath is the connector that provides access to the remote signal relays.

Terminal	Function
CN4.1	RL_1 contact (maximum 1 A resistive, see section 8.2)
CN4.2	
CN4.3	RL_2 contact (maximum 1 A resistive, see section 8.2)
CN4.4	
CN4.5	RL_3 contact (maximum 1 A resistive, see section 8.2)
CN4.6	
CN4.7	RL_4 contact (maximum 1 A resistive, see section 8.2)
CN4.8	

The optional RS-232 connector is also on this side. It is a female DB9 connector (corresponding to a DCE).

11.- Parameters

Number	Min	Default	Max	Units	Description
R_{00}	0	0	49		RL_1 function (see section 9)
R_{01}	0	30	49		RL_2 function (see section 9)
R_{02}	0	32	49		RL_3 function (see section 9)
R_{03}	0	34	49		RL_4 function (see section 9)
R_{04}	0,00	4,00	R_{05}	mA	4..20 mA input lower threshold
R_{05}	R_{04}	20,00	25,00	mA	4..20 mA input upper threshold
R_{06}	0,00	2,50	R_{07}	V	An_1 input lower threshold
R_{07}	R_{06}	5,00	10,00	V	An_1 input upper threshold
R_{08}	0,00	3,33	R_{09}	V	An_2 input lower threshold
R_{09}	R_{08}	6,66	10,00	V	An_2 input upper threshold
R_{10}	1	127	127		Timer 1 days (note 1)
R_{11}	00:00	08:00	R_{12}		Timer 1 start time
R_{12}	R11	09:00	23:59		Timer 1 stop time
R_{13}	1	127	127		Timer 2 days (note 1)
R_{14}	00:00	12:00	R_{15}		Timer 2 start time
R_{15}	R_{14}	13:00	23:59		Timer 2 stop time
R_{16}	1	127	127		Timer 3 days (note 1)
R_{17}	00:00	16:00	R_{18}		Timer 3 start time
R_{18}	R_{17}	17:00	23:59		Timer 3 stop time
R_{19}	1	127	127		Timer 4 days (note 1)
R_{20}	00:00	20:00	R_{21}		Timer 4 start time
R_{21}	R_{20}	21:00	23:59		Timer 4 stop time
R_{22}	0	20	R_{23}	ºC	Temperature lower threshold
R_{23}	R_{22}	25	60	ºC	Temperature upper threshold
R_{24}	1,800	2,000	R_{25}	V	Battery voltage lower threshold (per cell)
R_{25}	R_{24}	2,100	3,000	V	Battery voltage upper threshold (per cell)

Note 1: Sum of Sunday = 1, Monday = 2, Tuesday = 4, Wednesday = 8, Thursday = 16, Friday = 32, Saturday = 64

Number	Min	Default	Max	Units	Description
G_{00}	1,0	10,0	60,0	s	Start delay
G_{01}	1,0	10,0	60,0	s	Preheating time
G_{02}	1,0	5,0	20,0	s	Turning over time
G_{03}	5,0	10,0	60,0	s	Time between turn over retries
G_{04}	1	5	10		Number of retries
G_{05}	1	60	300	s	Motor heating time
G_{06}	1	60	300	s	Motor cooling time
G_{07}	10	60	40000	s	Minimum pause between cycles
G_{08}	0	0	40000	s	Maximum run time (note 1)
G_{09}	2,000	3,000	3,000	V	Maximum voltage per cell
G_{10}		CN3			Starting detection method
G_{11}		NO			Remote starting

Note 1: 0 means "no time limit"

Number	Min	Default	Max	Units	Description
O_{00}	2,0	4,0	19,9	s	Time between screen changes
O_{01}	0	900	7200	s	Screensaver delay (0 = disabled)
O_{02}		NO			Buzzer disabled
O_{03}	10	300	3600	s	Equalization time
O_{04}	0	0	33		Analog output function (section 6.2)
O_{05}	2400	9600	38400	bauds	RS-232 speed
O_{06}		NONE			RS-232 parity (none, even, odd)
O_{07}		ASCII			RS-232 mode (ASCII, MODBUS)
O_{08}	1	1	247		MODBUS address
O_{09}	0	0	9999		SIM PIN
O_{10}	0	0	999999999		Phone number #1
O_{11}	0	0	999999999		Phone number #2

Number	Min	Default	Max	Units	Description
B_{00}		OPzS			Battery installed (note 1)
B_{01}	B_{02}	2,625	3,000	V	High voltage warning
B_{02}	B_{03}	2,500	B_{01}	V	Equalization band upper value
B_{03}	B_{04}	2,450	B_{02}	V	Equalization band lower value
B_{04}	B_{05}	2,450	B_{03}	V	End of bulk charge
B_{05}	B_{06}	2,400	B_{04}	V	Floating band upper value
B_{06}	B_{07}	2,300	B_{05}	V	Floating band lower value
B_{07}	1,900	2,103	B_{06}	V	Force bulk charge
B_{08}	2,000	2,167	2,400	V	End of low voltage disconnection
B_{09}	B_{10}	1,853	2,000	V	Low voltage warning
B_{10}	1,667	1,833	B_{09}	V	Low voltage disconnection
B_{11}	B_{13}	2,400	3,000	V	Traffic light: yellow to green
B_{12}	B_{14}	2,050	B_{13}	V	Traffic light: red to yellow
B_{13}	B_{12}	2,167	B_{11}	V	Traffic light: green to yellow
B_{14}	1,667	1,875	B_{12}	V	Traffic light: yellow to red
B_{15}	0,0	3,0	9,9	mV/(V·ºC)	Temperature coefficient
B_{16}		Open			Technology (open or gel)

Note: All voltages are in volts per element (2 volts cell)
Note 1: See the options available in section 8. The User Defined battery is defined by parameters B01 to B16

If you have any questions about this manual or the RSD80v3 please send an email to tecnico@solener.com