

# Charging controller for solar power electric systems – SPSC-1T

SPSC1 charging controller is a device used to regulate power flow from solar module to lead-acid (sealed or open type) battery and to load in solar energy systems .

Device can be used in circuits of nominal voltage of both 12 and 24 volts.

Continuously checking voltage on the battery, the SPSC provides the following functions:

- overcharge protection (disconnecting the charging current)
- overdischarge protection (disconnecting the load current)
- battery condition monitoring
- continuous system status visualisation using LED lamps

## LED1 and LED2 status indicators:

LED1	LED2	System status
Red.	Green	
ON	OFF	Battery discharged, load disconnected, no charging.
ON	1,5Hz	Battery discharged, load disconnected, charging ON.
OFF	OFF	Battery OK, load connected, no charging
OFF	1,5Hz	Battery OK, load connected, charging in progress.
OFF	ON	Battery fully charged, load connected, charging disconnected.
1,5Hz	OFF	Abnormal mode – load voltage below 8V(16V), load and charging disconnected.
4Hz	OFF	Abnormal mode – temperature sensor malfunction , load and charging disconnected.
ON	ON	Restart/initializing

## Installation and Usage

Before mounting the unit, system voltage should be set, using jumper marked J, placed on PCB inside the unit. A drawing explaining proper settings for 12 or 24V systems is provided near the jumper, on radiator.

Available jumper settings:

JP2	open	Nominal system voltage: 24V
	closed	Nominal system voltage: 12V
JP1	open	temperature compensation OFF
	closed	temperature compensation ON

Position of the jumpers is read by microcontroller during initialisation (powering up). Changing jumper settings when unit is powered on does not have any effect. Jumpers should be placed exactly as shown on the drawing inside unit housing.

Mechanical installation begins with fixing the controller unit (four M4 or M5 screws, 70x140mm pitch) in system housing.

Optimal mounting for best heat dissipation is vertical, with terminals facing down. Mount the unit in dry place, allowing for unobstructed air flow – this is especially important when mounting the unit in the same housing with open(wet) type battery.

Electrical connections: begin with connecting battery (ACU terminals) make sure of proper polarity. Next, connect solar modules to BAT terminals, also watching polarity. Then connect load circuit (RL terminals) – depending on type of load, polarity also may be important.

**Warning: Incorrect installation of the unit can result in damage of other system components, and in extreme cases to a fire. Installation process should be done by trained person. In case of any doubts please consult the distributor or manufacturer.**

Wiring should be done with wires of diameter suitable for load and modules power. Terminal block allows 10mm<sup>2</sup> maximal wire profile.

Last part of the installation is placement of the temperature sensor, make sure of good thermal contact between sensor and battery – best place is one of battery terminals. The sensor is insulated from rest of the circuit. **Lack of thermal connection between sensor and battery, with thermal compensation turned on may result in battery damage or early wear.**

Electrical dismounting of the controller unit should be done in reverse order, i.e. load, solar module, battery.

Battery selection: When choosing battery, its capacity should be at 0.4-2.0Ah per Watt of solar module rating in 12V systems (0.2-1.0Ah/W in 24V systems).

Using battery of too small capacity may result in battery damage or reduced lifetime due to exceeding maximal charging power. Additionally too small capacity may result in rapid voltage changes over charging/discharging cycles.

Using too big capacity of battery will result in permanent undercharge of the cells, and that may lead to reduced performance due to cells sulfurisation.

After initialisation, if battery voltage is over  $U_a$  level, the controller connects the load. If any abnormal condition occurs, both load and supply circuits are disconnected. After the cause of abnormal status is removed (for example fuse replaced) the controller will reconnect the load only if battery voltage exceeds  $U_b$  level. If, after abnormal status occurs, the load must be connected despite lower battery voltage, the controller should be disconnected from battery and modules, allowing for restart/initialization. Disconnection procedure should be done in order described above.

30A fuse protects battery circuit. If load circuit is shorted, the fuse stops current flow from the battery (which could be in hundreds of Amperes range) and eliminates fire risk.

The fuse can not be used as main power switch in the system. Removing the fuse while system is charged/loaded does not stop the current in load circuit, as the solar module still provides the power. Load will be powered as long, as voltage at load is in  $U_a \dots U_d$  range. If voltage at load circuit drops below  $U_a$  level, the load will be disconnected, as the controller falls in “battery fully discharged” status.

If voltage at load circuit exceeds  $U_d$  level – controller will disconnect module from load circuit.

In both above cases controller will detect Load Voltage Low state (load voltage below 8V) and disconnect load and charging until the fuse is in place. Practically this scenario will be rare due to significantly nonlinear internal resistance of solar module. If user needs to disconnect load from the system – an external main switch should be provided.

Wiring of the system, condition of battery, level of electrolyte (wet cells), should be periodically checked.

Bad condition of battery (sulfurisation, aging, low capacity, internal short-circuit) will result in: system instability, rapid changes of charging current, rapid changes in load voltage.

If the controller is found to work instably it should be disconnected from the system and repaired/replaced.

Due to specific solar module disconnecting circuit construction requirements, the controller can not be used in systems powered by sources other than solar modules.

Fuse should not be replaced under load.

### **Technical data SPSC-1T**

#### **Typical data**

Parameter	Symbol	Value for system voltage:	
		12V	24V
Load disconnect voltage	$U_a$	11,2V±1,5%	22,4V±1,5%
Load connect voltage	$U_b$	12,6V±1,5%	25,2V±1,5%
Charging stop voltage (temperature compensation OFF)	$U_c$	13,8V±1,5%	27,6V±1,5%
Charging stop voltage (temperature compensation ON)	$U_c$	see description	see description
Charging start voltage (temperature compensation OFF)	$U_d$	13,5V±1,5%	27,0V±1,5%
Charging start voltage (temperature compensation ON)	$U_d$	see description	see description
Temperature compensation non-linearity		3%	3%
Under-voltage protection level	$U_l$	8,00V±1,5%	16,0V±1,5%
Quiescent current	$I_s$	5 mA typ. ; 10 mA max.	
Unit dimensions	$W \times L \times H$	98mm×150mm×45mm	
Temperature sensor lead length	$L_s$	1m	
Unit weight	$w$	600g	
Terminal block	-	6×10mm <sup>2</sup>	

Values of  $U_a$ ,  $U_b$ ,  $U_c$ ,  $U_d$  and temperature compensation characteristics may be modified on request at ordering.

## Absolute maximum ratings

Parameter	Symbol	Value for system voltage	
		12V	24V
Battery voltage range (ACU terminals)	$U_{ACU}$	10-40V	
Solar module max voltage (BAT terminals)	$U_{BAT}$	50V	
Solar module max power rating	$P_{PV}$	4500W	900W
Load current max	$I_L$	30A	
Charging current max	$I_{CH}$	30A	
Solar module short circuit current max	$I_{SC}$	50A	
Power dissipation in controller max	$P_D$	35W	
Unit housing temperature max	tr	100°C	
Ambient temperature range	$\Delta ta$	-30°C - +50°C	
Air humidity max	Hm	80%	
Fuse rating	-	30A	