QRPworks

SolMate™

Solar Charge Controller

User Manual
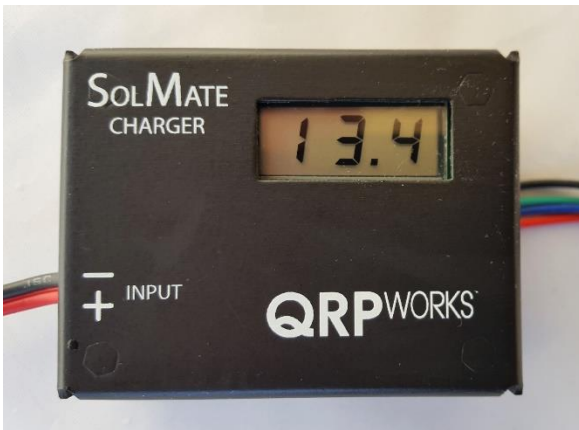
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Overview

This manual describes how to use the QRPworks *SolMate* solar charge controller.

SolMate is a flexible solar charge controller that can charge a variety of battery technologies.

SolMate features include:

- The ability to charge your battery at the same time the battery is being used to run your rig.

- Display of seven measurements during the charging process.

- Short circuit, reverse polarity, and thermal overload protection

- High efficiency Maximum Power Point Tracking (MPPT) technology used to extract the maximum power from your solar panel.


Applicability

SolMate can charge the following batteries:

- 14 volt, 4 cell LiFePo batteries that have a built in Battery Management System (BMS…balanced charger and protection circuit), such as those from Bioenno Power.

- 12 volt SLA batteries (gel cells)

- 11.1 volt, 3 cell Li-Ion batteries that have a built in in Battery Management System (BMS…balanced charger and protection circuit (such as the Tenergy batteries used in the Elecraft KX2)

SolMate is not intended for and should not be used with batteries that do not have a built in Battery Management System and require a balanced charger.

Connections
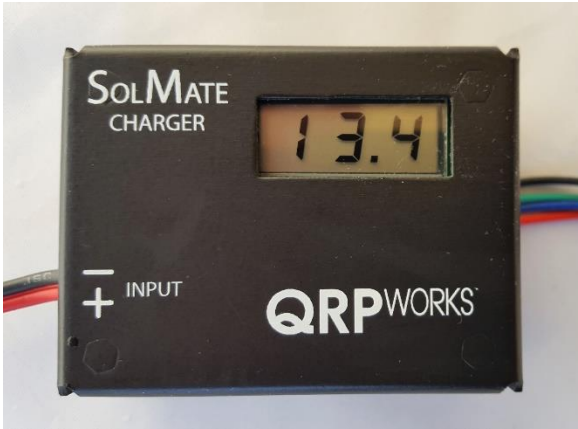
- Connect a solar panel DC output to the INPUT +/- screws terminal connections on the left side of SolMate (as pictured).

    o The maximum input voltage is 23 volts.

- Use the appropriate **SolMate** battery-specific cable for the battery type to be charged to avoid charging a battery with the incorrect voltage.   Each cable is identified by a label on it.

  Cable types available are:

    o 14 volt 4 cell LiFePo / SLA
    o 11.1 volt 3 cell Li-Ion

  SolMate comes with a cable of your choice. Additional cables are available if you want to charge multiple battery types.

  Caution: Make sure you use the proper cable for the battery to be charged. Using the incorrect cable could result in damage to the battery, battery fire or explosion.

  SolMate is not designed to charge batteries that do not have a built-in Battery Management System (BMS). Batteries with a

BMS have built-in balanced charging and protection. Batteries that do not have a BMS require an external balanced charger that charge each cell separately. Typically, these can be found in hobby shops.

Output

Use the appropriate *SolMate* output cable for the battery type to be charged. The cables have programming resistors that select the output voltage as marked on the label. Never use the 14 volt cable to charge a 3 cell Li-Ion 11.1 battery pack or fire will be a likely result.

The cables are polarized to avoid accidental misuse. Female 2.1mm charging connectors are used for batteries such as the Bioenno Power LiFePo batteries (or equivalent packs).

The 11.1v charging cable is for use with 3 cell Li-Ion packs as supplied by Elecraft and Tenergy (and others) which have a MALE connector on the battery pack. These batteries have a built in charging and protection circuits, which are required, as SolMate is not a balanced charger (does not charge each cell) as you might see with some hobby battery systems.

One cable type of your choosing is supplied with SolMate.

The *SolMate* charging cable is a **Y** configuration for 4 cell LiFePo batteries that will simultaneously connect to the female barrel connector (2.1mm) on most Bioenno Power and similar battery packs as well as to any radio using a 2.1mm female power connector.

The battery connector on the cable can be used to charge a 12 volt SLA battery. Do not connect the charge controller to the rig's 2.1mm female power input connector without the battery also being connected.

The Li-Ion 11.1v *SolMate* **Y** charging cable will charge the Elecraft KX2 battery (or equivalent) and connect to the rig at the same time. The

battery must be external to the rig for simultaneous charging and the radio's power source. Do not connect the charge controller to the rig's 2.1mm female power input connector without the battery also being connected.

Remember, this charge controller is a battery charging device, not a power supply.

Displays

The LCD Display scrolls through the following seven measurements items every 25 seconds. The function title is displayed, followed by its value.

Display	Function
bAt	**Bat**tery Voltage
PAN	Solar **Pan**el Input Voltage
A	Output current in **A**mps
Out	**Out**put power in Watts
P - P	**P**eak **P**ower in Watts
A - H	Cumulative output **A**mp-**H**ours
b - t	*SolMate* PC **b**oard **t**emperature in degrees F

In addition, you may also see the following on the display:

- Full – indicating the battery is fully charged. Note that you will also this if no battery is connected, as no current is being drawn from SolMate
- O.L - Input Over voltage
- Hot - Thermal Shutdown above 160 F (Flashing)
- SOC – ignore
- USb – ignore

Theory of Operation

At the heart of SolMate is a very efficient DC-DC Power converter which transfers up to 90% of the panel's energy to the battery. The power converter is controlled by a microprocessor which performs the Maximum Power Point Tracking, collects and tabulates data, and drives the LCD display.

The SolMate controller works from below 1 Watt to 25 Watts of output (35 Watt STC rated solar panel). No adjustments are needed as the board is fully automatic and will adapt to any panel within its specification limits. Our customized Maximum Power Point Tracking (MPPT) routine adjusts the power transfer over 2500 times per second to yield maximum performance even in partial shading of the solar panels from shadows (clouds, trees, utility poles etc.).

Rapid sunlight changes on a partly sunny day are not a problem either. The microprocessor monitors input and output parameters while always seeking the maximum power possible. There are two control loops working together to get every last watt of power from the solar panel. The result is up to **two times** the Power than a PWM charge controller would deliver with the same solar panel.

SolMate uses a sophisticated spread spectrum modulation technique to reduce EMI to a virtually undetectable level across the ham bands. PWM charge controllers are notorious for their high levels of EMI, making them unsuitable in amateur radio applications.

SolMate Specifications

Solar Panel Input
- Solar Panel Range = 5 to 25 Watts STC Rating. Larger panels can be used, but SolMate will use 25 watts max.
- Input Voltage Range = 10 to 22 volts
- Optimum input voltage = 14 to 18 volts
- Input Over-voltage = 23 volts
- Solar MPPT range = 10 to 22 volts
- Ideal for 36 cell solar panels with a 16 to 17 MPPT voltage and 21.5 open circuit voltage

Output
- Output Voltage: 14.4 volts max (battery type dependent)
- Output Current:
    - 11.1 volt Li-Ion: 1.35 amps max
    - 14.4 volt LiFePo: 1.25 amps max

Operating Temperature Range
- -4 to 120F (Internal Thermal Limit at 160F)
- LCD display will be sluggish below 32F

Converter Efficiency
- 85% typical at 15 Watts
- Switching Frequency 130 KHz nominal with Spread Spectrum Modulation to reduce EMI further

Accuracy
- Voltage accuracy 1% Typical
- Current Accuracy 5% at 1 amp typical
- Amp hour accuracy 5% typical

Protection
- Soft thermal fold back at 150F
- Thermal shutdown at 160F
- Output short circuit
- Input reverse polarity

Digital Processing

- 32 MHz Microprocessor for fast MPPT control
- Internal 24 bit Processing