Solar Controller

Systems designed to operate from solar power need as a minimum a solar panel and a battery. The solar panel will charge the battery during periods of daylight and the battery will continue to provide power at night. However, without a controller there is a high probability that the battery would be damaged by overcharging during periods of strong sunlight. Furthermore the battery will discharge through the solar panel at night. Finally, if the battery is disconnected the solar panel output voltage can rise significantly and damage the load.

A solar controller is therefore needed to regulate the battery. Most of these are designed for high power systems, and draw a significant current. Although this is not relevant if large panels are used, many monitoring systems only require a small amount of power, so can be driven from small solar panels and batteries. In some cases a commercially-available controller will consume more power than the load, necessitating large panels than would otherwise be needed.

1 Introduction

The 7044 Solar Controller is designed to address all these issues:

It performs a number of functions:

1.1 Identify the Battery Type

When the 7044 is first connected it disables the solar panel and the load and monitors the battery to identify if it is 12V or 24V. If no battery is connected it remains in this state.

1.2 Charging the Battery

Once the 7044 has identified the battery type it continually monitors the battery voltage. If it falls below a low level it sets a boost charge mode whereby it uses all power available from the solar panel to charge the battery to the cyclic charge limit voltage. It then switches back to its normal mode where it attempts to maintain the battery at the float charge level by switching the panel on and off as required.

The cyclic charge limit and the float charge level are temperature-dependent, so the 7044 monitors the temperature and adjusts the limits accordingly, on the assumption that it is at the same temperature as the battery.

To disable the solar panel the 7044 applies a short-circuit across it. This is the preferred method, rather than disconnecting it.

1.3 Controlling Power to the Load

A solar panel functions as a current source, and will output up to twice its rated voltage into an open-circuit (or low current load). Therefore, if the battery fails, or is disconnected, there is a risk of damaging the load by over-voltage. The 7044 overcomes this by disconnecting the load immediately it detects a step rise in the supply voltage, or if the level exceeds an upper limit.

It also disconnects the load if the battery becomes excessively discharged to prevent it fully discharging if the solar panel is disconnected or fails.

1.4 Generating an Alarm Output

The 7044 is intended for powering telemetry equipment at unmanned sites, so it is important that it is able to report via telemetry if there is a fault that may result in impending loss of operation.

It therefore provides a digital output which is a logic '1' state (i.e. +5V) when the system is healthy, but drops to logic '0' (i.e. 0V) if the battery voltage falls below a low limit that would suggest it is not receiving enough charge to maintain the system. When this alarm is raised it is probable that the system will fail some time later, but the time will depend on the battery capacity and the load being drawn from it.

1.5 Providing an Analogue Output

The 7044 also provides an analogue output so a telemetry system can monitor the battery voltage if required. This output is scaled to $1/400^{th}$ of the battery voltage, so 100mV equates to 40V, with an output impedance of 250R.

1.6 Indicating the System Status

The 7044 includes two LED indicators, marked 'Charging' and 'Charged'. In normal operation only one of these will flash. When the battery is maintained in its float charge status it is likely that the indication will alternate between 'Charging' and 'Charged'.

If a fault condition occurs both LED's will flash. Fault conditions occur if the battery is disconnected or open circuit, if it is below the low voltage alarm threshold or if it is below a lower threshold that defines it as being excessively discharged. In the latter case the unit will disconnect the load to prevent further discharge.

2 Specifications

Battery Voltage:	12V or 24V, automatically detected
Maximum solar panel size:	75W @ 12V, 150W @ 24V
Current drawn by controller:	< 500µA
Low Voltage Alarm Output	0/5V @ 5mA max

3 Connection Details

1. Solar Panel +
2. Solar Panel –
3. Battery –
4. Battery +
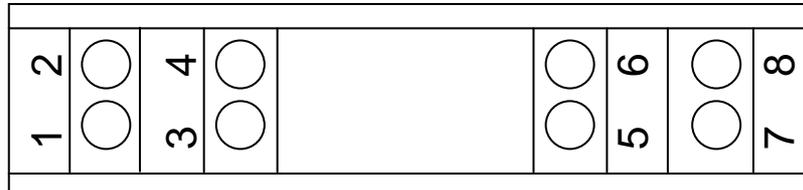
5. Battery Low Alarm
6. Battery Volts Monitor
7. Load –
8. Load +

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