CHURCHILL CONTROLS

Data_Link 2000

SOLAR POWER CONTROLLER

The 7041 Solar Power Controller is a DIN-rail mounted module primarily designed as the interface between a solar power panel, a lead acid battery and a load. However, it can also be used as a general-purpose battery monitor.

The module performs a number of functions:

1. **It float-charges a lead-acid battery to a full charge state when the solar panel is producing power, whilst ensuring that the battery does not discharge into the solar panel at night.**
2. **It provides a fused power output from the battery**
3. **It provides visual indication of the charge state**
4. **It provides a digital 'Low Battery Volts' alarm output**
5. **It provides a battery volts monitor compatible with *Nano_Link* analogue inputs.**

Before describing the product an understanding of solar power is necessary:

A photo-voltaic solar panel produces output power which is proportional to the light intensity. In strong sunlight the power is obviously at its maximum. The average power produced through a 24 hour period in winter is less than in summer, both because the sun's intensity is lower and because there are fewer daylight hours.

A battery must therefore be used to store energy. The battery must be sized to be able to power the load for typically 30 days to allow for extended periods of bad weather during the winter. The solar panel must be sized to ensure it is capable of keeping the battery charged during typical winter weather. It will then produce excess power during the summer, and a controller is needed to ensure that this does not result in the battery being over-charged. The power consumed by the controller must be taken into consideration when calculating the size of the battery and the solar panel.

A number of factors influence the power delivered by a solar power supply, including its geographic location, the operating temperature, the direction in which it is pointing, any obstruction in the path of the sunlight and the nature of the load being powered by it. A more northerly location will have less sunlight, but will generally be colder, so the panel will be more efficient. Optimally the panels should track the sun, but it is more practical to fix them pointing south, at an inclination to the horizon of typically 10^{o} greater than the angle of latitude of the site (this ensures maximum sunlight, and also ensures that rainfall will help keep the surface clean). The load includes the controller, the battery self-discharge and the battery inefficiency. Calculating the power available from a panel is therefore quite complex, and is best done using a computer programme.

The source impedance of a solar panel is relatively high, so it approximates to a variable current source. Solar power controllers therefore regulate the power delivered to the battery by shorting out the solar panel when the battery is fully charged.

Special Features

The 7041 Solar Power Controller has been specially designed for use with low-power equipment such as telemetry outstations, although it can supply up to 5A at 12V. Its internal power consumption has been minimised, thus reducing the overall power requirements, allowing the use of smaller solar panels and batteries. It also provides digital and analogue outputs which can be telemetered to a remote location to allow operators to monitor the state of the system.

Operation

The 7041 Solar Power Controller has 8 terminals. One pair is for the solar panel, another for connection to a lead-acid battery and a third provides power to the load. The remaining two terminals provide a Battery Low digital output and a Battery Volts monitor. Battery Low is an open-collector transistor which is pulled to 0V when the battery is healthy, and switches off when the battery level drops below a defined limit. The Battery Volts monitor is calibrated to give 0…100mV for a battery voltage range of 0…20V.

There are also two LED indicators, marked **Charging** and **Charged**.

The load is connected to the battery via an internal 5A self-resetting fuse. If a fault occurs the fuse will trip, but it will automatically recover when the load is removed.

If the solar panel is producing power, and the battery is not fully charged, the **Charging** LED will flash at a rate of about 10 pulses/second. When the battery reaches its full charge the **Charged** and **Charging** LED's will flash alternately. If the solar panel stops producing power (e.g. at night) the **Charged** LED only will flash. If the battery discharges below a defined voltage the **Charged** LED flash rate will drop to around 1 pulse/second, and the Battery Low output will switch off.

When the solar panel is producing power, the controller can regulate the power delivered to the battery by shorting out the solar panel to prevent the battery over-charging. This occurs progressively, depending on the battery state and the current produced by the solar panel, such that enough charge is delivered to the battery to keep it 'topped up'. The visual effect is that the **Charging** and **Charged** LED's flash alternately, at a variable duty cycle.

Note that, since the controller is a shunt regulator, the solar panel should never be replaced with a conventional power supply.

Monitoring 12VDC supplies

The controller can be used to monitor existing 12VDC supplies, by omitting the battery and Solar Panel. It will monitor the voltage level applied to the 12V output, and generate Battery Low and Battery Volts monitor outputs from it.

Using with *Nano_Link* outstations

The controller is optimised for use with ***Nano_Link*** outstations. The Battery Low output can be connected directly to a digital input to allow the status to be monitored remotely. Similarly, the Battery Volts output can be connected to one of the outstation analogue inputs (configured for 0…100mV sensitivity) to allow the battery level to be monitored, if required.

Specifications:

Maximum permitted current from solar panel	5A
Maximum current to/from battery	5A
Internal current consumption	750µA
Battery float charge voltage	13.8V
Battery Low voltage limit	10.8V
Battery Low output low level sink current max (@ 1.5V)	8mA
Battery Low output high level (max)	36V
Battery monitor output load (min)	100KΩ

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