Tracking Solar Panel

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This small 12 V solar power source maintains its orientation towards the sun under control of a timer rather than the more usual light-sensitive arrangement. All the parts needed to build the project can be found in a well-stocked hardware shop or DIY store.

The axle is made from the core of a roller blind with two bearings. Suitable angle brackets are readily available to hold these bearings. The axis of rotation is set vertically, and the whole thing is directly driven by a battery-powered rotisserie motor. This motor already includes a gearbox to give a slow rotation and is capable of turning in either direction, and so one could hardly ask for a more perfect device for the job.

The upper end of the roller blind axle must be filed down to a suitable (generally square) cross section to allow it to be driven by the rotisserie motor.
Now to the electrical department to find a cheap electronic mains timeswitch. The

switch must be programmable for at least four on-off cycles per day. For the solar panel itself any 12 V solar charger designed for car, camping or boat use is ideal. It should be at most 0.25 m^2 in area as otherwise the force of the wind may be too great for the gears in the rotisserie motor's gearbox to withstand. The angle of inclination of the module is fixed, and depends on the latitude at which it is installed.

The mains portion of the timeswitch and the switching relay are not required and are removed. The remainder of the timeswitch will act as a clock which causes the axle to be rotated eight times during the course of each day: each on-to-off or off-to-on transition of the clock will advance the axle by 22.5 degrees from east to west via south. The angle through which the roller

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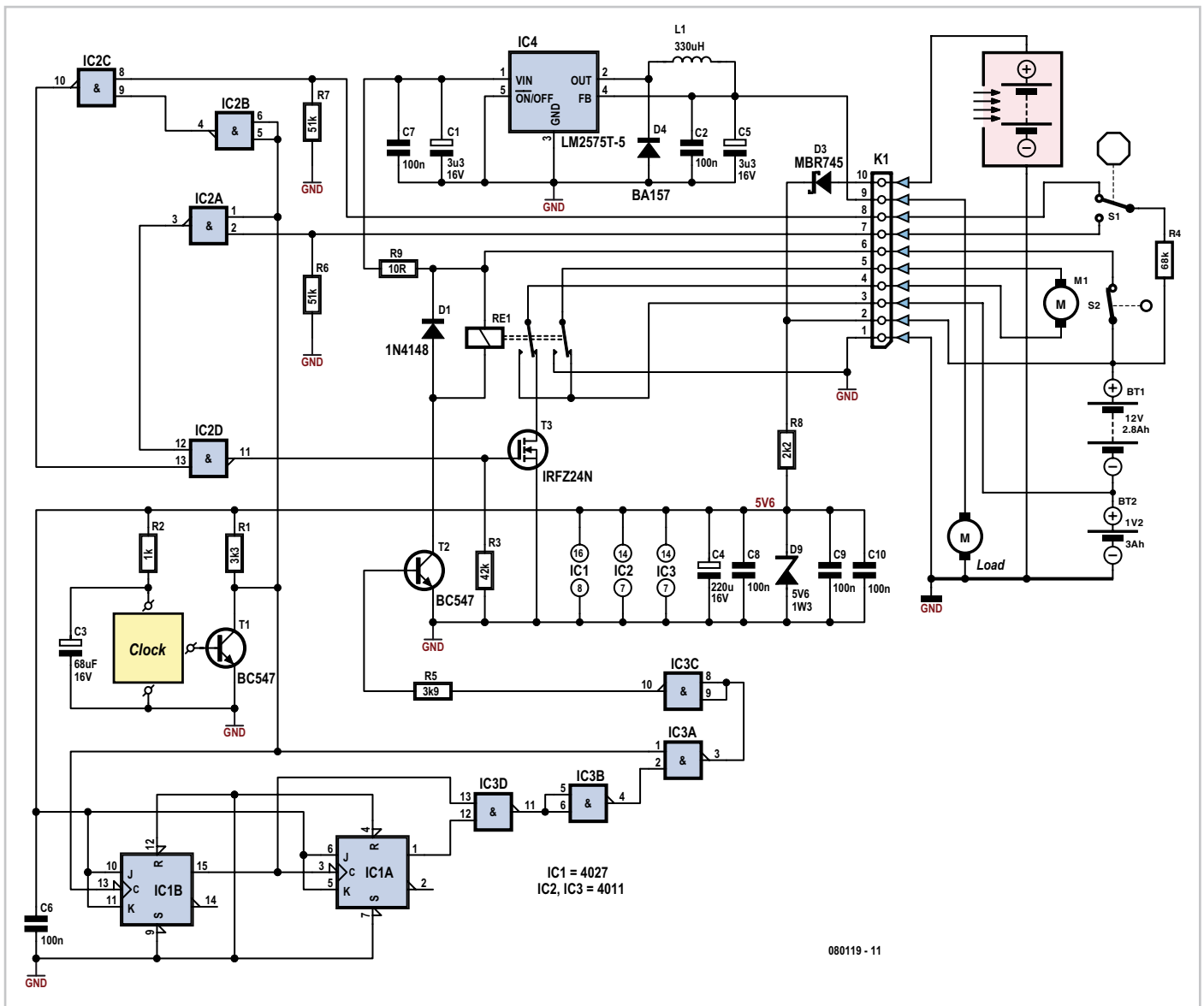
blind axle turns is defined by its octagonal shape: the corners operate a microswitch S1, which is fitted with an actuation lever. The position of the microswitch must be set carefully so that the switch is closed when the lever is pushed aside by a corner and open when between corners. Each time the timeswitch changes state IC2, a CMOS 4011 which contains four NAND gates, switches the drive motor on via p-channel MOSFET T3 for as long as necessary until the microswitch also changes state. Reasonable settings for the timeswitch have been found to be as follows: 7.30 am on; 9.00 am off; 10.30 am on; 12 noon off; 2.00 pm on; 4.00 pm off; 6.00 pm on; and 9.00 pm off.

After eight moves the solar panel has rotated through a total of 180 degrees and points directly west. Counter IC1, constructed from the two CMOS JK flip-flops in a 4027, detects the eighth clock pulse and turns on relay Re1 via IC3. This in turn reverses the polarity of the power to the motor and the panel starts to turn back from west to east. When it reaches its original position facing due east limit microswitch S2, actuated directly by the solar panel, opens. The connected load is also switched on and off by S2, which is open during the night and closed during the day.

The author uses his solar panel to operate a small water pump. For this purpose the output of the panel is regulated to 5 V using a highly efficient switching regulator. Alternatively, 12 V lighting could be powered from the panel, with no need for the regulator.

Of course, both the control electronics and the timeswitch need to be housed in a waterproof enclosure. Energy storage to cover for the inevitable cloudy days can be provided by a 12 V battery comprising ten 2800 mAh AA-size NiMH cells in a suitable battery holder, which can be fitted inside an ordinary electrical junction box. A 3000 mAh D cell is fitted in the battery compartment of the rotisserie motor, wired in series with the 12 V battery and also charged from the solar panel.

The motor and battery connections from the rotisserie motor are taken to the control circuit using a four-core cable. The rotisserie motor's switch is removed. Resistor and capacitor values shown in the circuit are not particularly critical, and other similar types can be substituted for T1, T2 and T3. A Schottky diode should be used for D3, which prevents current flow back into the solar panel, in order to minimise power losses. The 5 V regulator operates at around 250 kHz and so a high-speed switching diode is needed for D4. Using an ordinary 1N4007 considerably reduces the efficiency of the regulator and is therefore not a good idea. A small toroidal-core inductor is used for L1.