The Solarbotics MILLER ENGINE (under license from AM Innovations)

The Miller Solarengine (MSE) is a simple, effective Type-1 solarengine with a configurable discharge time that can drive both inductive and non-inductive loads. The advantage of this solarengine is that it can allow for frequent very high level bursts of energy that last for only a set period of time, rather than letting stored power run completely out as with traditional 3904/3906 type solarengines. Originally designed by Andrew Miller in 1995, this Solarengine design has been distilled to this most optimum layout.

The 1381 drives a power transistor or FET via it's CMOS output for a period determined by the value of the time discharge capacitor, C2.

The diode D1 is any standard signal diode (i.e.:1N914), which adds approximately 0.7V to the trigger value of the 1381 selected (ie: C trigger is 2.2V trigger plus 0.7 = 2.9V trigger voltage). More diodes can be added in series to further increase the trigger voltage in 0.7V steps (for standard signal diodes).

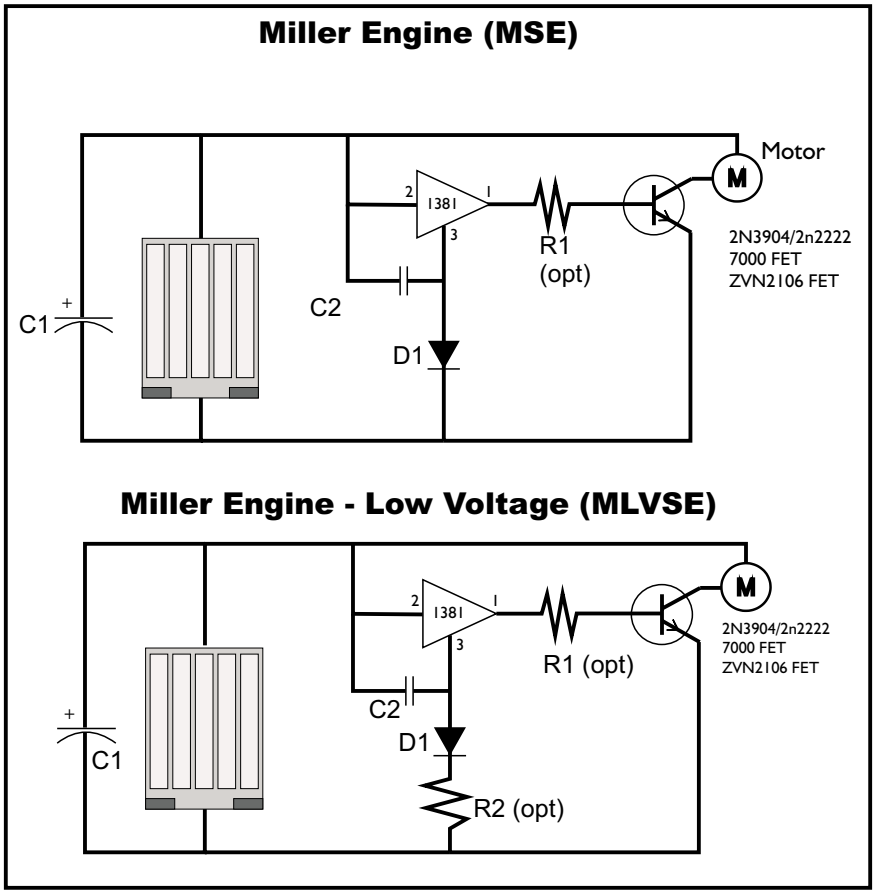
C1 should be a high value capacitor, along the lines of a 0.33F 2.5V Panasonic Gold AL capacitor. If voltages required are higher than the cap value, placing two in series is advisable (2 x 0.33F caps in series = 1 cap 0.167F at 5V maximum rating).

C2 sets the hysterisis value (the on time) by keeping the voltage the 1381 sees above it's shut-off voltage. The value of C2 is highly dependant on the drive component selected. For FETs, values of 0.1µF to 10µF give pulses 0.4 to 4 seconds long. When using BJT (standard) transistors, the capacitor value should range anywhere from 47µF to 1000µF, giving pulses durations between 0.4 to 2 seconds long. Experimentation is required based on your device load.

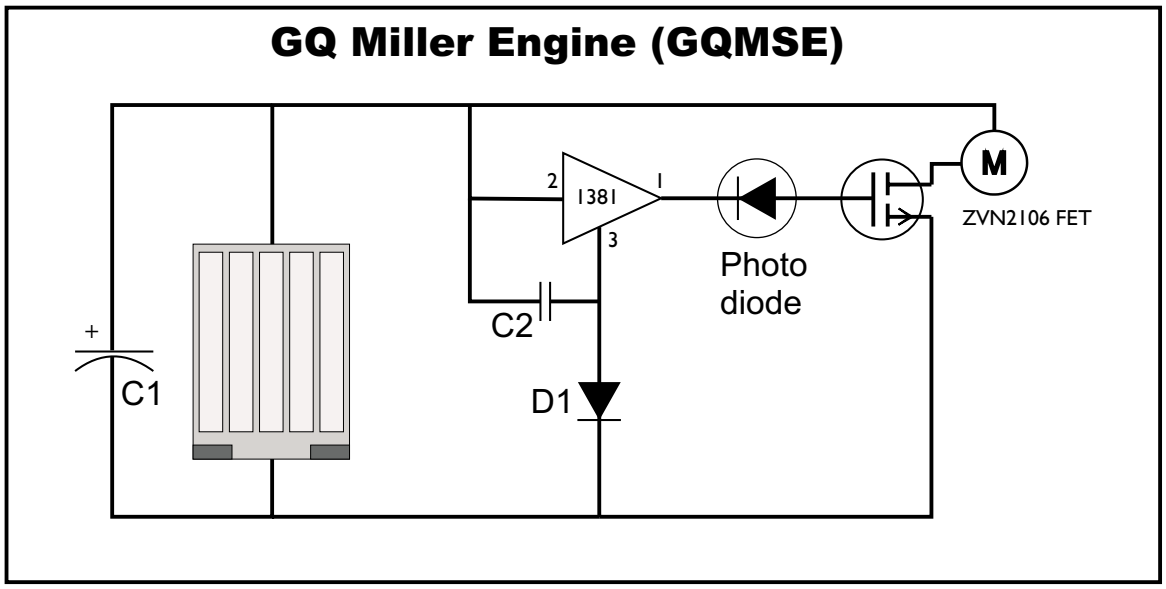
Current limiting resistor R1 is only really necessary for designs using transistors, and are optional for FET variations. 2.2k being standard, other values of 470 ohm to 10k are quite suitable depending on your application.

If low-voltage (lower than the 1381C set at 2.9V) operation is required, a germanium diode can be used instead of the standard 1N914, which will lower the voltage step from 0.7V to 0.4V. This means a 1381C setup will activate at approximately 2.6V rather than the 2.9V using a standard silicon diode.

For even lower voltage use, substitute a wire for the diode, and place a 20k resistor (R2) between the ground leg of the 1381 **after** C2 and the ground rail. C2 will have to be raised appropriately, as it will now discharge through the 1381 *and* the resistor.



Change this:	Motor Time On:	Time to Recharge:	Result:
Larger C1 Storage Cap	Same	Same	Longer initial charge-up, quick, high-energy bursts. This is because C2 sets how long it stays on for. Make C2 larger to increase how long it stays on for when increasing C1.
Larger Solarcell	Same	Quicker	Quicker initial charge-up and recharge times.
Larger C2 Timer Cap	Longer	Longer	The motors stays on longer, which pulls more power out of the capacitor. This takes longer to recharge, but gives a longer motor pulse.
Smaller C2 Timer Cap	Shorter	Shorter	This will result in quick, high-energy bursts, but won't spin the motor for as long.
Higher 1381 Trigger	Same	Longer	The 1381 sets at what voltage the circuit activates. If it gets too high, it gets harder for the solarcell to charge the circuit up to that point.
Larger R1 Resistor	Longer	A bit longer	Raising the R1 reduces how much power can go through the motor (Ie: it won't spin as "hard"). It will also keep the circuit on longer because the power flow from C2 slowed down, taking longer to discharge.



The Modified "GQ" Solarengine

This variation of the Solarengine is a modification by Mike Trecieski (a.k.a.: "GQ") that he used in his killer Solaroller "One-O'clock Wonder" at the 2001 Western Canadian Robot Games. He simply added a forward-biased photodiode between the output of the 1381 and the gate of the FET. When the 1381 turns on, the photodiode adds an additional 0.6V to the gate voltage, turning the FET on HARD. There was a remarkable increase in performance with this simple add-on. "One-O'Clock Wonder" went from 30cm bursts to practically double that!