The Solarbotics Bicore Experimenter's PCB

The MSE1 Miller SolarEngine

SE SolarEngine

The MSE1 Miller SolarEngine Module is a simple, reliable, and very configurable solar energy power source for practically any solar BEAM application. It drives both inductive (i.e.:motors, coils) and non-inductive (i.e.: LEDs, other circuitry) equally well. The MSE1 is a Type2/1 solarengine, meaning it uses a voltage trigger, with a timer discharge. That is, it uses the 1381 voltage trigger IC to set the activation voltage, and the C2 capacitor to set how long it stays on for once its reached the activation point.

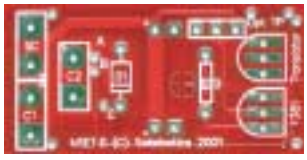
Necessary Parts:
1 x Solarcell (SC)
1 x Storage Capacitor 1000μF - 1.0F+ (C1)
1 x Discharge-time Capacitor 0.1μF(FET) - 1000μF (NPN) (C2)
1 x 1381 Voltage Detector
1 x NPN Transistor / N-Channel FET
1 x Diode (D1)

Other Parts:
1 x 20kΩ Optional Trimpot (MVSE modification) (Opt TP)

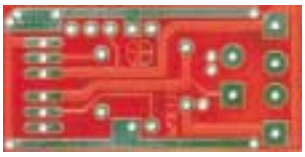
The MSE1 is usable as in short-burst (small C1, C2), long-burst (large C1, C2), and a high-energy burst (large C1, small C2) modes, allowing it to give the driven load exactly the characteristic you desire. By default, it's designed to use a NPN transistor (2n2222, 3904, ZTX450, etc), but you can also substitute in a low-voltage N-channel FET (ZVN2106 / 2n7000) with excellent results. By doing so, you can reduce the size of the C2 discharge capacitor from the 22-1000μF range to 0.1-1.0μF range, and still get very good drive capability.

Another feature of this particular implementation of the MSE1 is the option of modifying it into a MVSE - a "Miller Variable SolarEngine". With appropriate modifications and the addition of a 20k trimpot, you can dial in the point you wish the MVSE to activate at. This may be appealing to those who do not have a large variety of 1381 voltage triggers to choose from, or those needing more accurate adjustments than swapping 1381s.

One thing to note is that the MSE1/MVSE is a "ground switching" solarengine. That is, it acts by turning on/off the ground line to the circuit it's driving. It shouldn't prove to be a problem with most circuits, but it may be worth remembering while troubleshooting.



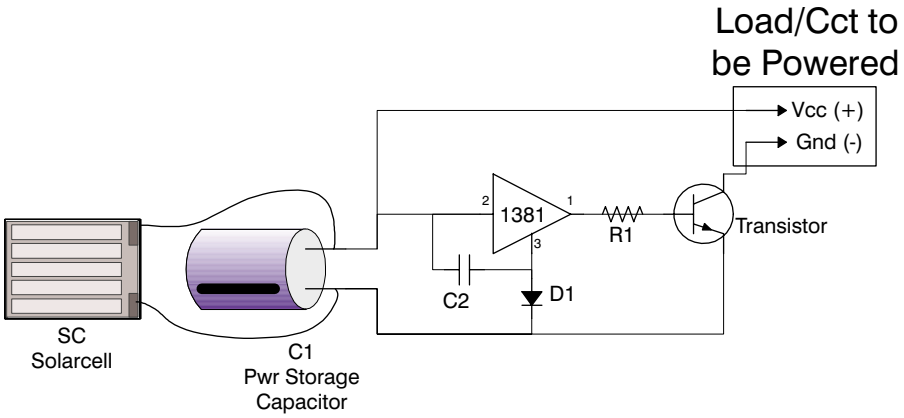
Top



Bottom

- Bare Top/Bottom Edge Rail of PCB is Output Ground (-).
- Center Rail pads are Vcc (+).

- Note polarity markings near SC & C1 for proper mounting of power storage capacitor and solarcell.
- Polarity marking on C2 must be observed for mounting large capacitors.
- R1 is optional base current limiting resistor. 1381 outputs ~5mA maximum, so use R1 for efficiency tweaking .



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MSE1 Application Notes

SE SolarEngine

$$T = \frac{CV}{I}$$

T = time in seconds
C = Capacitance in farads
V = voltage rating of 1381 trigger (if calculating from initial, ZERO voltage state), or the change in voltage from trigger to trigger (i.e.: 2.7V down to 2.2V = 0.5V change).
I = current in amperes

Since the charge curve of a solar cell charging a capacitor is nearly linear due to the solar cell acting as a constant current source, the above equation will give an approximate charging time.

$$T = \frac{0.33F \quad 2.7V}{0.016A}$$

Example 1: Calculate from initial zero-charge the time to charge a 0.33F capacitor up to 2.7V from a 16mA solarcell (using a SC2433). The time required would be around 55 seconds.

$$T = \frac{0.33F \quad 0.5V}{0.016A}$$

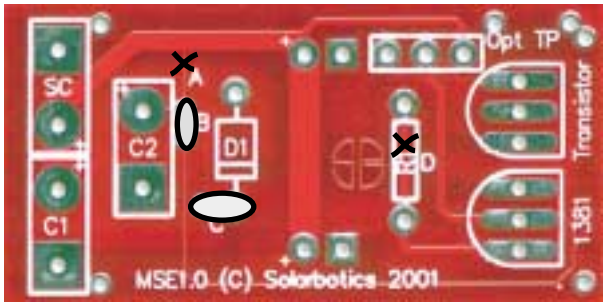
Example 2: Given the same circuit, calculate how long it will take to recycle from a 0.5V voltage drop? T = 10 seconds!

1381 Trigger Values using the standard MSE configuration:

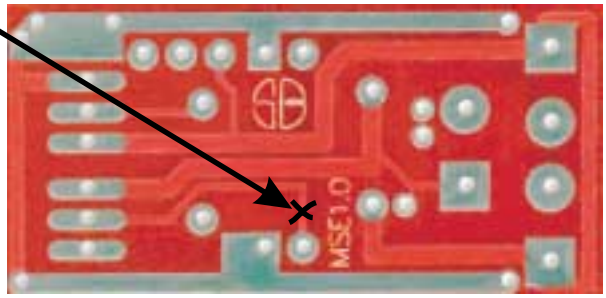
C = 2.51V
E = 2.63V
G = 2.99V
J = 3.22V
L = 3.66V
N = 4.07V
Q = 4.36V
S = 4.94V
U = 5.36V

MVSE Modification Instructions:

1) Cut trace at point "A".
2) Create a jumper using solder across two small pads at "B".
3) Create another solder jumper across two pads at "C". Diode D1 is not necessary - remove if you wish.
4) Cut trace at point "D" under the "R1" text)
5) Add a 1k (or similar) resistor at "R1" to raise the transistor bias so it doesn't pull excessive base current.
6) Cut the trace from Vcc to the 1381 pin 2, near the "MSE1.0" text on the underside.
7) Install 20k Trimpot at "Opt TP"



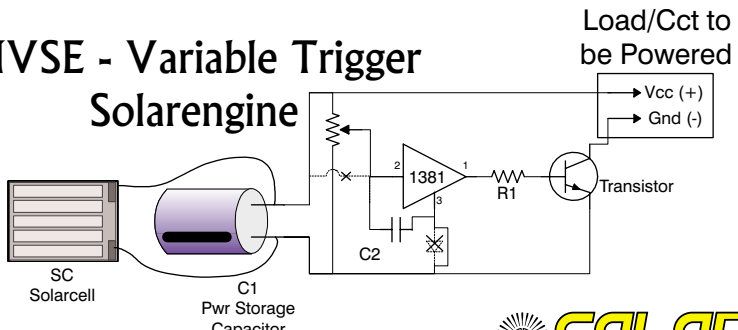
Top (2X Scale)



Bottom (2X Scale)

When in MVSE configuration, adjusting the 1381 trigger voltage will also change the duration the trigger stays on. The higher the voltage trigger, the longer the on-time duration.

MVSE - Variable Trigger Solarengine



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