

This series/parallel charge pump is a kind of DC-DC-converter.

Basic idea

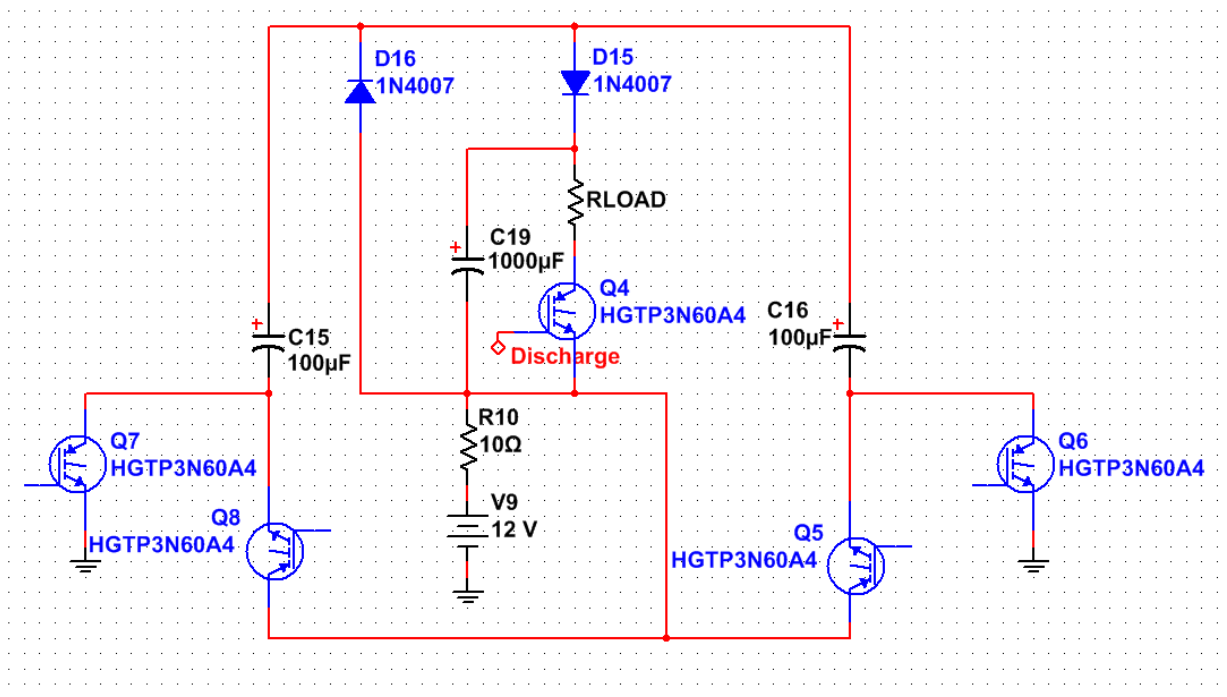
Capacitor cluster 1 is configured in a parallel configuration with an energy source. Then capacitor cluster 1 is configured in a series configuration with the energy source and both elements are configured in a parallel configuration with capacitor cluster 2. Then the roles of capacitor clusters 1 and 2 are swapped.

During each iteration, the voltage across the receiving capacitor cluster increases. After a number of iterations both capacitor clusters are discharged to a recovery capacitor with significantly larger capacitance than the sum of the capacitance of the two capacitor clusters. This will reduce the voltage in the circuit. The circuit states are:

- Parallel – Serial, No discharge
- Serial – Parallel, No discharge
- ...
- Parallel – Serial, No discharge
- Serial – Parallel, No discharge
- Parallel – Parallel, Discharge
- ...

The energy source is a 12V laboratory power supply in parallel configuration with the recovery capacitor. The power supply is current limited at 500mA.

A 10 ohm resistor (R10) in series with the energy source limits current during testing. RLOAD is 100 ohm when testing.



Description

In parallel/serial configuration, Q7=ON, Q8=OFF, Q5=ON, Q6=OFF, Q4=OFF. In serial/parallel configuration, Q7=OFF, Q8=ON, Q5=OFF, Q6=ON, Q4=OFF. In parallel/parallel/discharge configuration, Q7=ON, Q8=OFF, Q5=OFF, Q6=ON, Q4=ON.

When Q4=ON, at discharge to C19, the circuit capacitance is expanded by the availability of C19 in parallel with C15 and C16. This lowers the circuit voltage according to $E=\frac{1}{2}CV^2$. Electrons are accelerated through the load conductor.

The two parallel circuits seems to be correct, C15 or C16 are charged from V9. For the two series circuits, we have V9 in series with C15 (C16) charging C16 (C15) respectively. Also correct as far as I can understand. However I would like to re-use part of the energy left over in C19 from the previous discharge to re-charge C15/C16 to achieve a higher efficiency. C19 should source as much energy as possible and V9 should only source enough energy to compensate for the energy losses in the circuit. C19 seems to not be connected to accomplish this in the current design.