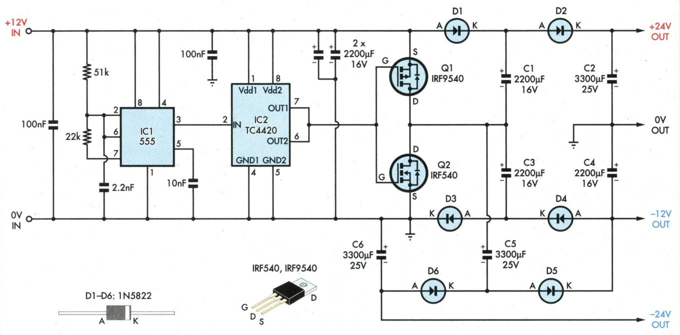

12V to ±24V switched capacitor supply

This circuit is able to deliver a nominal ±24V from a 12V supply. Depending on the exact components used and an adequate 12V supply, it is possible to draw up to 1.5A from each rail. The output voltages are not regulated and will be slightly less than double the input voltage.

One potential application is obtaining regulated ±15V rails from a lead-acid battery (eg, in a car), by adding 7815 and 7915 3-terminal regulators. It could also be handy if you want to generate a split supply from a switchmode plugpack. High current 12V supplies are cheaper and more plentiful than high current AC plugpacks.

Note that there will be switching noise in the output and this will be proportional to the output current drain.

The NE555 is configured as an astable oscillator running at around 6.5kHz, with a 50% duty cycle. Its square wave output drives a TC4420 high-current low-side Mosfet driver (available at **www.futurlec.com**).

Complementary Mosfets Q1 and Q2 are configured as a CMOS inverter. Their drains are joined together and to three capacitors so that they drive three charge pumps via six diodes. When the drain junction swings low, capacitor C1 charges up to 12V via diode D1. When this junction swings high again, the positive terminal of C1 is boosted to double this, ie, 24V and capacitor C2 is charged to this voltage via diode D2.

The Mosfet driver ensures that the gate capacitances of both Mosfets are charged and discharged rapidly. This is important since it minimises the amount of "shoot-through" current which flows during switching, when both Q1 and Q2 are briefly turned on simultaneously.

All the diodes specified are high current Schottky types to minimise switching and forward voltage losses. Since the frequency as shown is only 6.5kHz, standard silicon rectifiers would work but efficiency would drop and the heat output would increase.

Generating the -24V rail is a little trickier since it has to be done in two stages. Diodes D3 & D4 together with capacitors C3 & C4 first generate -12V. When the drain junction is high, C3 charges up to 12V via D3. When it goes low, the lower end of C3 swings to -12V and this charges C4 via D4. The same principle is used again, this time with -12V as the source, to generate -24V via D5, D6, C5 & C6.

As the current drain increases, the output voltages will drop. There are several factors which limit how much current you can draw from the output.

First, there is the 3A limit of each diode. Because the input current is necessarily higher than the output current, ie, the output power product (V x I) can not exceed the input power product, the current through D1 is twice that drawn from the +24V output. Similarly, the current through D3, D4 & D5 is twice that drawn from the -24V output. Therefore, larger diodes are necessary if you are to exceed the 1.5A figure.

Additionally, all the current must pass through the switched capacitors, C1 for the +24V rail and C3 & C5 for the negative rail, as well as the storage capacitor C4. In fact, C1, C3, C4 & C5 have twice the output current flow through them for the same reasons as the diodes mentioned previously. If you are going to draw a significant amount of current from the output, you must use physically large capacitors.

Ideally, use low ESR capacitors or else several in parallel, otherwise you might exceed the ripple current ratings, causing excessive internal heating and damage. The values and voltages shown are those used in the prototype but they should be considered minimums. Ensure that the ripple current ratings of the capacitors used are sufficient for your application and remember that some pass double the output current.

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