Voltage Doubler Using Timer 555

DEEPAK GUPTA

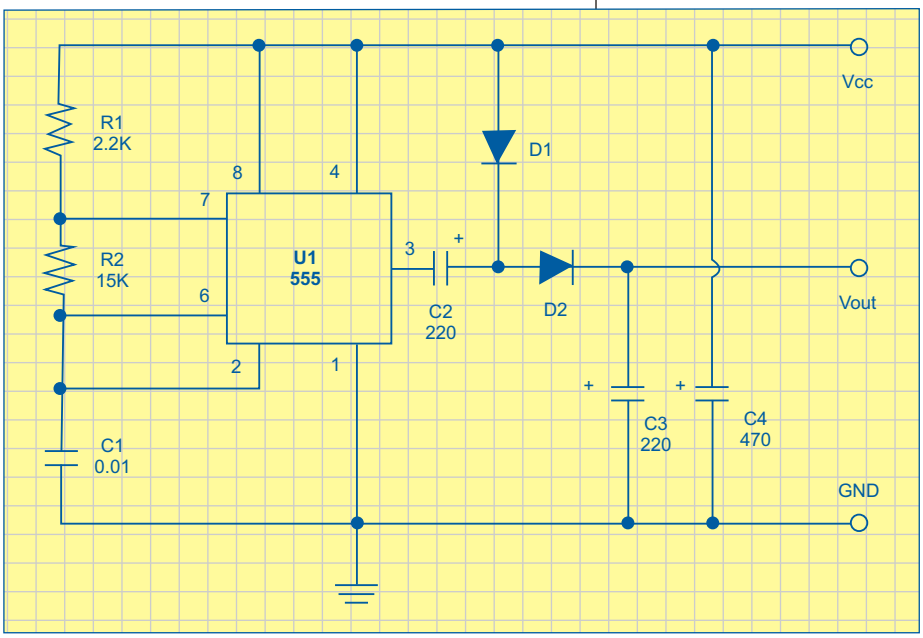
Frontline Electronics, Pvt. Ltd., Salem

A voltage higher than the supply can be created by a "Charge-Pump" circuit created with a 555, diodes and capacitors as shown in the following circuit. The output will deliver about 50mA .

This is a circuit that outputs a voltage Vout that is approximately twice the level of the Vcc voltage.

The circuit uses a 555 timer IC configured as an astable multivibrator.An astable multivibrator is a timing circuit whose 'low' and 'high' states are both unstable. As such, the output of an astable multivibrator toggles between 'low' and 'high' continuously, in effect generating a train of pulses. This circuit is therefore also known as a 'pulse generator' circuit.

In this circuit, capacitor C1 charges through R1 and R2, eventually building up enough voltage to trigger an internal comparator to toggle the output flip-flop. Once toggled, the flip-flop discharges C1 through R2 into pin 7, which is the discharge pin. When C1's voltage becomes low enough, another internal comparator is triggered to toggle the output flip-flop. This once again allows C1 to charge up through R1 and R2 and the cycle starts all over again.



C1's charge-up time t1 is given by: t1 = 0.693(R1+R2)C1. C1's discharge time t2 is given by: t2 = 0.693(R2)C1. Thus, the total period of one cycle is t1+t2 = 0.693 C1(R1+2R2). The frequency f of the output wave is the reciprocal of this period, and is therefore given by: f = 1.44/(C1(R1+2R2)), wherein f is in Hz if R1 and R2 are in megaohms and C1 is in microfarads.

When the circuit is powered up and the 555 output (pin 3) goes to logic '1' for the very first time, its near-Vcc voltage level causes C3 to charge up through D2 and also reach near-Vcc level. When the output goes to logic '0', C2 charges from Vcc through D1, also to a near-Vcc level. When the 555 output goes back to logic '1' again, C3 may still have some (if not most) of its charge left, and will allow to charge up to a higher level since it is now effectively in parallel with the series circuit of the 555 level '1' output and the charged C2. After several cycles of C2 and C3 alternately charging, C3 will subsequently build up a voltage level equal to almost twice the Vcc level. This C3 voltage comes from the charge pumped in by the sum of the C2 voltage (near-Vcc) and the 555 output voltage when it is at logic '1' (also near-Vcc). At this point, the output Vout of the circuit will already be almost twice the Vcc level.