040 Simple Frequency Doubler

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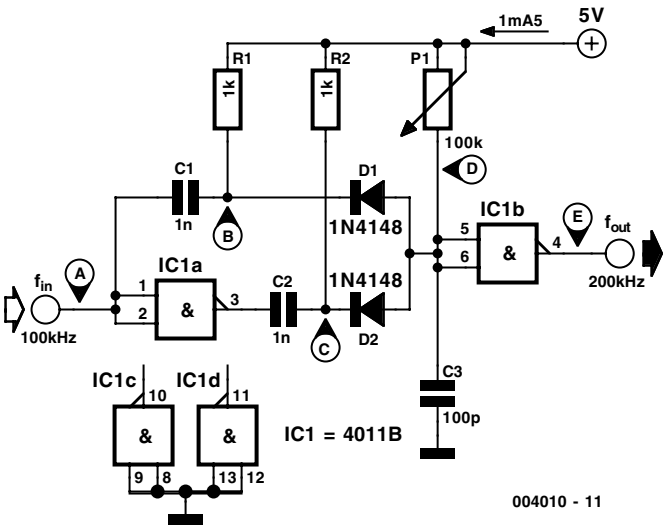
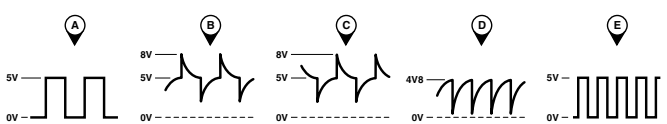
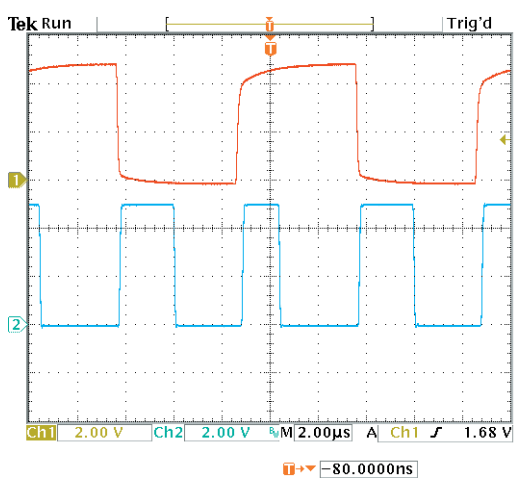
Using just a few discrete components and two inverters, it is possible to build a simple TTL square wave frequency doubler for signals up to about 100 kHz. The input signal is applied to the differentiating circuit R1-C1. This converts the rising edge of the square wave into a positive pulse and the falling edge into a negative pulse. The inverter IC1a (you could use a NAND or NOR gate with the inputs tied together) inverts the input square wave and applies it to the differentiating circuit R2-C2. This differentiator performs the same function as R1-C1 i.e., producing positive pulses on rising edges and negative pulses on falling edges but in opposite phase to the output of R1/C1. The two diodes only pass the negative parts of the two signals, so at the anodes we get a series of negative pulses at a frequency of twice the input signal.

The output consists of a capacitor, which is charged up through preset R3. Each negative pulse stops the charging process and quickly discharges the capacitor. The resultant sawtooth waveform is applied to the input to IC1b (actually,







the slopes of the waveform are not linear but exponential). The final inverter converts this signal back into a square wave but with twice the frequency of the input signal. The on/off ratio of the output square wave can be adjusted by preset R3, which will alter the time constant of R3-C3.

The current consumption of the frequency doubler is approximately 1.5 mA at 5 V. The low value of R1 means that the design has a low input impedance and the input current to IC1 is greater than the suggested maximum in the data sheet for this type of IC. It is therefore important that the supply voltage is not increased above +5 V.

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