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ENEE 417 Experiments Week 6
Week starting 03/02/09
Design #3: Voltage Doubler

1. Use available components in the circuits of S. Chjekcheyev a7 T. Moldova, "Voltage Doubler improves accuracy," of EDN, February 5, 2009, p. 51, repeated here.

Voltage doubler improves accuracy

S Chekcheyev, Tiraspol, Moldova

The voltage doubler in **Figure 1** provides more accurate voltage doubling than does the conventional voltage doubler in **Figure 2** because it uses transistors instead of diodes. You can express the output voltage of the conventional doubler as $V_{OUTDC}=2V_{INAC}-2V_D$, where V_{OUTDC} is the output dc voltage, V_{INAC} is the amplitude of the input ac voltage, and V_D is the voltage across the forward-biased diodes. The error of the conventional voltage doubler is $2V_D$. Transistors Q_1 and Q_2 in **Figure 1** are saturated during the positive and the negative half-cycles, respectively, of the input ac voltage. The operation of the saturated transistors is similar to the operation of the forward-biased diodes in **Figure 2**. The collector-emitter voltage of the saturated bipolar transistors, however, is substantially smaller than the voltage across the forward-biased diodes. Thus, the error of doubling decreases.

Transistors Q_1 and Q_2 are reverse-biased during the negative and the positive half-cycles, respectively. The reverse beta of the bipolar transistors is small; consequently, the operation of the reversed transistors in **Figure 1** is similar to the operation of the reverse-biased diodes in **Figure 2**. Both circuits underwent tests with a resistive load of 10 kΩ and a 50-Hz, 2V-amplitude sinusoidal signal applied to the input. The measured output voltage of the conventional voltage doubler was 2.8V, and the error of doubling was 2×2V−2.8V=1.2V. The measured output voltage of the proposed voltage doubler was 3.8V, and the error of doubling was 2×2V−3.8V=0.2V.EDN

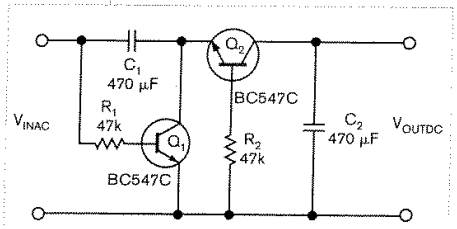

Figure 1 An improved voltage doubler uses transistors for better accuracy.

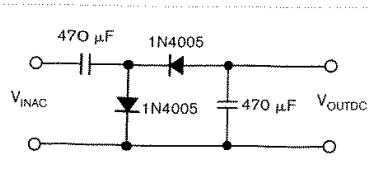

Figure 2 A conventional voltage doubler uses diodes.

2. Test this using a signal generator and the Tektronix 220 oscilloscope. Capture, into an Excel file using the GPIB controlled by LabVIEW, the voltages at every node in the circuit. Compare your results with those of the EDN article.
3. Repeat part 2 by generating and measuring the signals via LabVIEW.
4. Derive equations for the voltages at every node in the circuit and check these against the measurements.
5. Write a one to three page report summarizing your results.