Additional end-of-chapter problems for Chapter 18 – Special Purpose CMOS Circuits

*CMOS: Circuit Design, Layout, and Simulation*

**A18.1** We know from problem 6.14 on page 160 that MOSFETs connected in series with their gates tied together behave like a single MOSFET with a length equal to the sum of each individual MOSFETs lengths. Reviewing the Schmitt trigger in Fig. 18.3 and the derivation of its switching point voltages we assumed M1 was operating in the saturation region when switching takes place. Is this a correct assumption? Why? If M3 and M6 are removed what is the resulting circuit called?

**A18.2** Show, using SPICE, that the following structure can be used as a Schmitt trigger. Derive equations governing the operation of the circuit. Note that MFB will have to be “weak” (long length) for general operation.

**A18.3** Repeat problem 18.7 on page 549 using the long-channel CMOS devices (Table 6.2 on page 147) for an oscillation frequency of 10 MHz. Use SPICE to simulate the operation of your design.

**Figure A18.2** An alternative Schmitt trigger topology

Out

M1

*VDD*

In

M2

M2

*VDD*

M4

*VDD*

MFB

**18.4** Show, using a SPICE DC sweep, that the input buffer topology seen below can be designed to have hysteresis. Use, except for MFB, the device sizes seen in Fig. 18.17. Design an input buffer with 100 mV of hysteresis. Use this design to show how noise can be eliminated on an input waveform (see, for example, Fig. 18.2 on page 524).

**Figure A18.4** An input buffer with hysteresis.

Out

*VDD*

Inm

M2

*VDD*

M4

*VDD*

MFB

*VDD*

Inp

**18.5** Simulate the operation of the charge-pump clock driver seen in Fig. 18.39 on page 546 using a SPICE transient analysis. Plot the maximum output amplitude against load capacitance for the design.