1. **LM311 Comparator**

Make the LM311 comparator circuit of Fig. 1:

(a) Drive it with a 10kHz, 1Vpp square wave. What is the risetime of $V_2$?

(b) Now drive it with a sine wave and look at $V_1$ and $V_2$ simultaneously. Qualitatively describe the action of the comparator.

(c) For very gentle sine wave slopes, the 311 will oscillate. Try it and describe.

2. **The Schmitt Trigger**

The Schmitt trigger circuit in Figure 2 will fix the oscillations of the preceding section.

(a) Predict the “on” and “off” trigger thresholds.

(b) Construct the Schmitt trigger circuit and verify your prediction.

(c) Connect pin 1 to -15V. Are the new “on” and “off” levels correct?

3. **RC Oscillator**

Consider the RC oscillator circuit in Fig. 3:

(a) Calculate the period of the RC oscillator and sketch $V_1$, $V_2$ and $V_3$ versus time, where

$$ T \propto 2.2RC \quad (1) $$

(b) Make the circuit and compare with calculations and timing sketches.

4. **The 555 Oscillator**

Consider the 555 timing circuit of Fig. 4:

(a) Calculate the LO and HI times of the 555 oscillator.

$$ t_{HI} = 0.7(R_A + R_B) \cdot C \quad (2) $$

$$ t_{LO} = 0.7R_B \cdot C \quad (3) $$

(b) Make the circuit and verify your times. Also look at $V_1$, $V_2$ and $V_3$. Can you explain them?

(c) Save this circuit; you’ll need it shortly.
5. The 4066 Analog Switch

(Caution: The inputs to this chip are CMOS and subject to static charge blowout. Do not touch the pins with your hands.)

Here we use a 4066 CMOS analog switch, as depicted in Fig. 5, which requires switching voltages of Vss (use 0V) and Vdd (use 15V). It will only take analog voltages V such that

\[ V_{ss} < V < V_{dd} \]  

(4)

Exceeding those ranges will kill the chip.

(a) Use the DC offset on your function generator to achieve \( V_1 = 2V_{AC} \) riding on a +7VDC offset at 10kHz.

(b) Make the circuit.

(c) Find the “on” resistance of the analog switch by measuring \( V_1 \) and \( V_2 \) (either AC or DC) and calculating \( R_{on} \).

(d) Without changing the input, reconnect the output across a 100kΩ resistor and make a working switch. Turn it off and on by sticking the \( V_3 \) lead in either ground or +15V busses.

(e) Connect \( V_3 \) to the output of the 555 oscillator (hopefully still intact) of Section 4, so that the 555 turns the switch off and on. Look at the oscillator output on Chan 1 of your scope and the switch output on Chan 2. Explain the waveform.

FIG. 5: The 4066 Analog Switch circuit of Section 5.