

# Analog meets Digital:

Two additional exercises (2009)

1. Potentiometer test (no response required in lab report)  
→ 50k potentiometer (or any value > 1k)

(a) use a multimeter to identify the fixed & wiper pins



(The wiper pin moves as you turn the pot.)

(b) Connect the potentiometer across the  $\pm 12V$  power supply on the prototyping board, and use a multimeter to observe how the DC output voltage varies as you change the wiper. (Be sure to allow enough time for the multimeter to ~~observe~~ <sup>observe</sup> the measurement before moving the wiper again.)

## 2. Comparator

requires:

LM311N comparator

4.7k resistor (~~more or less~~ or 5.1k)

100k resistor

potentiometer (50k typical)

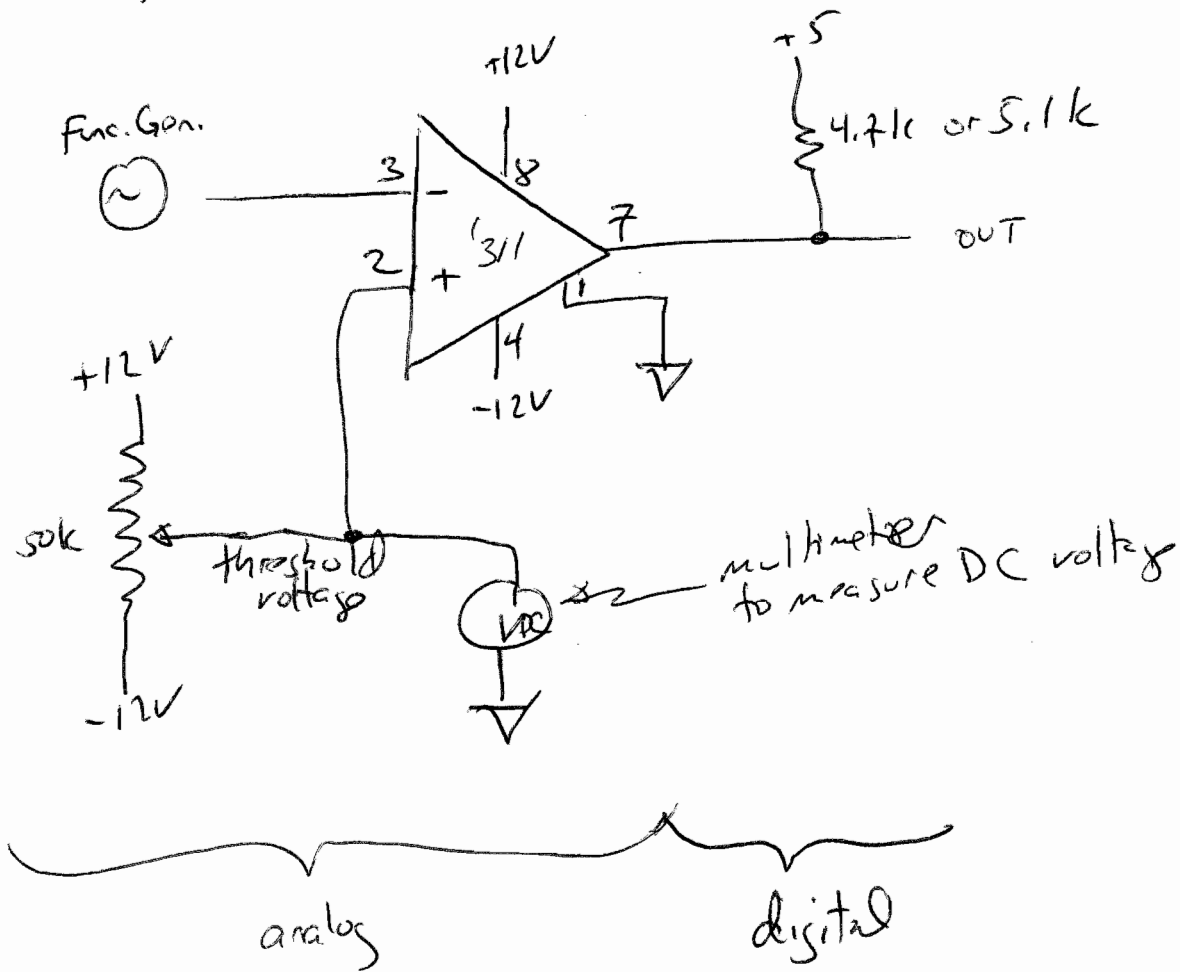
### Overview:

(a) You will observe how a comparator will output a (relatively) clean digital output (+5V or 0V) depending on whether an ~~input~~ analog input voltage is  $>$  or  $<$  than a threshold voltage. You will establish the threshold voltage using a potentiometer.

(b) You will observe an undesired oscillation in the comparator's output, and ~~remove~~ <sup>diminish</sup> this oscillation by adding positive feedback to the comparator.

(a) Comparator procedure:

connect the comparator chip to the:  
±12 V power supply (for analog)  
+5 V " " (for digital)  
as shown below, using the func generator to provide the analog input waveform:



• Adjust the func. gen to provide an output:  
8V peak-peak sine wave, 1.5 kHz  
(digital)

• On the oscilloscope, observe the comparator output on CH1 and the sine wave ~~input~~ (analog) input on CH2. Trigger the scope on CH1 using the falling edge. Use 100 μs/division for the horizontal display.

part (ii)  
(continued)

(4)

- Record the oscilloscope display when the threshold is set to the following two values: (i) +3V  
(ii) 0V

- Discuss, quantitatively, ~~how~~ the ~~the~~ output digital waveform changes states in response to:
  - upgoing analog input voltage
  - downgoing " " " "

(b) Now zoom in to the downgoing change in digital output voltage by using 250 nsec/div. on the oscilloscope's horizontal display.

- Record an image of the "ringing" or "oscillations" present in the digital output (typical time scale ~ 200 nsec)
- Now connect a 100k resistor between the output pin 7 & the non-inverting input pin 2 of the comparator. This provides positive feedback. Record the waveform. Discuss whether the undesired oscillations are diminished by using positive feedback.