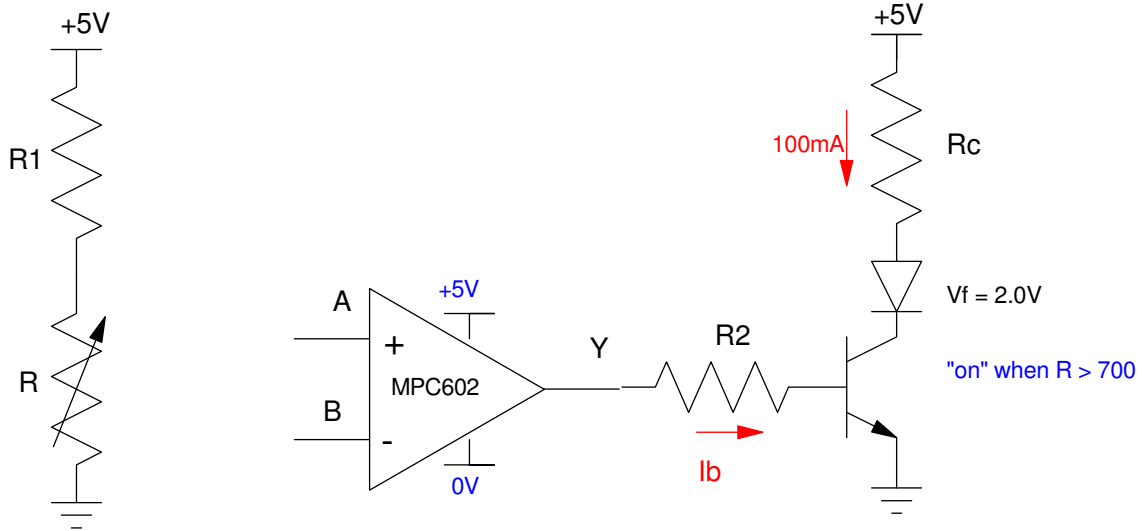# ECE 320: Handout #14
Comparitors & Schmitt Triggers

Comparitor: Design a circuit which turns on a yellow LED when R > 700 Ohms. Assume

- $\beta = 100$
- "on" means 100mA
- The op-amp can output 25mA (max)

+5V

R1

R

+5V

A

+

MPC602

B

-

0V

Y

R2

Ib

+5V

100mA

Rc

Vf = 2.0V

"on" when R > 700

Schmitt Trigger: Design a circuit which turns on a yellow LED when R > 700 and off when R < 600

+5V

R1

R

A

+

MCP602

B

-

0V

Y

R2

Ib

+5V

Rc

100mA

Vf = 2.0V

On when R > 700
Off when R < 600

3904
NPN
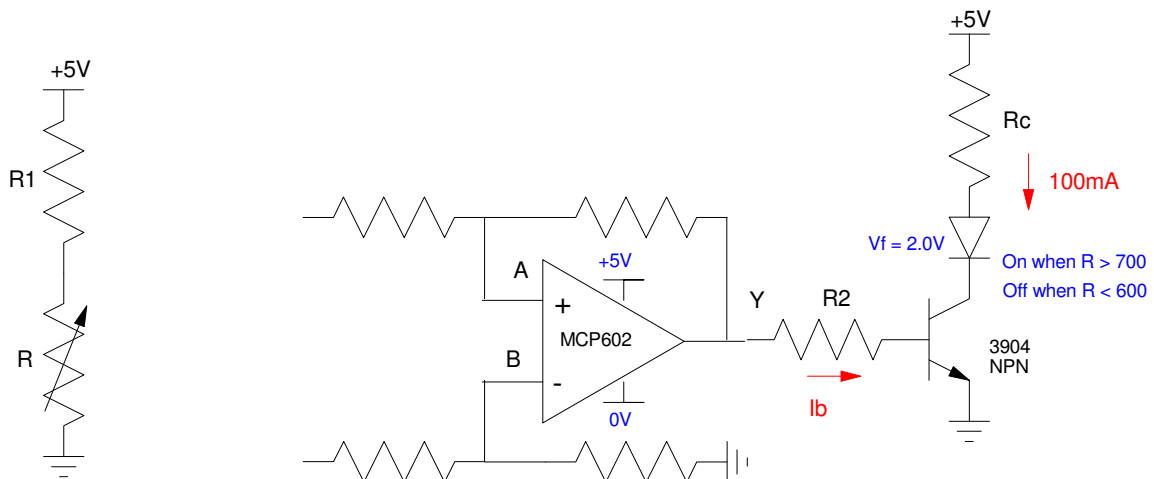
Comparitor

Assume R1 = 1k (somewhat arbitrary). The voltage corresponding to 700 Ohms is

$$V_x = \left(\frac{700}{700+1000}\right)5V = 2.059V$$

When R goes up, Vx goes up and Y goes up. Connect to the + input (A)

Connect the - input to 2.059V (B)

Pick Rc so that Ic = 100mA

$$R_c = \left(\frac{5V-2.0V-0.2V}{100mA}\right) = 28\Omega$$

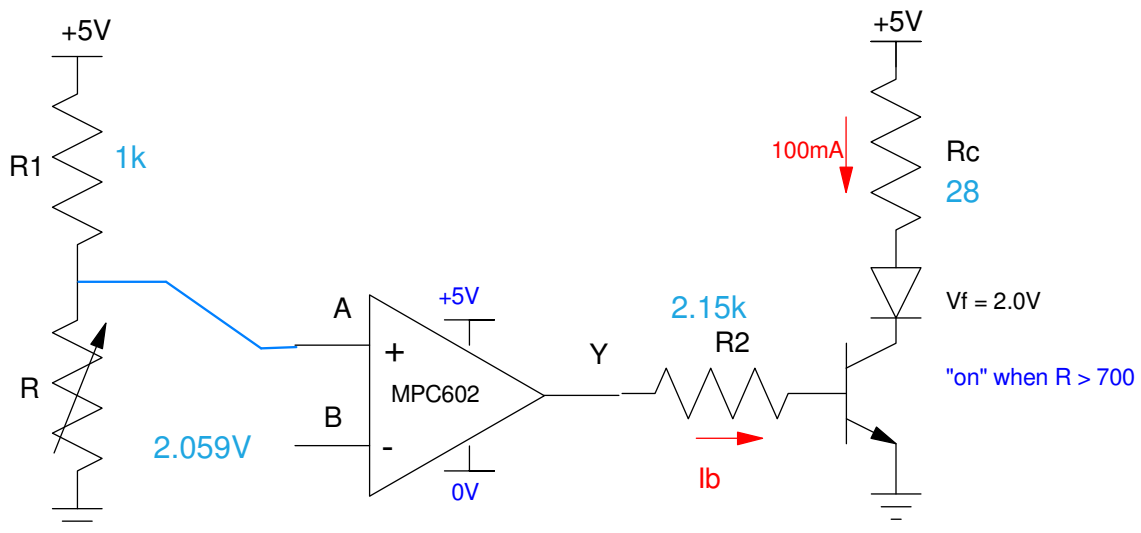Pick Rb so that the transistor is saturated

$$\beta I_b > I_c$$

$$I_b > 1mA$$

Let Ib = 2mA

$$R_b = \frac{5V-0.7V}{2mA} = 2.15k\Omega$$

Schmitt Trigger

R2 and Rc are unchanged. Let R1 = 1000

R = 700: Y = 5V (on)

- $V_x = \left(\frac{700}{700+1000}\right)5V = 2.059V$

R = 600: Y = 0V (off)

- $V_x = \left(\frac{600}{600+1000}\right)5V = 1.875V$

As Vx goes up, Y goes up. Connect to the + input

When Y = 0V, you switch when Vx = 2.059V. Make the offset 2.059V

The gain needed is

$$gain = \left(\frac{\text{change in output}}{\text{change in input}}\right) = \left(\frac{5V-0V}{2.059V-1.875V}\right) = 27.20$$

Pick the resistors in a 27.2 : 1 ratio. Make them large so that the loading on R is small