f. All of these capacitors didn't show the switch bouncing. This makes sense because all of these have a bigger capacitance than the one we used in class, which was small enough to prevent button bounces.

g. 20 kΩ is the worst case because it allows maximum current to flow. With maximum current flowing, the wires would have a lot of ~~energy~~ current which increases the chances of the button bouncing. With a 50 kΩ resistor, there is less current flowing in the circuit and the chances of electricity jumping between switch plates is less. Basically, the chances of button bouncing is reduced.

Lab 3

1.a. The circuit would still work. If V_{in} goes down a little bit, V_{out} would start decreasing rapidly. Since the difference between V_+ & V_- should be 0 and ~~since~~ V_{out}'s connection to V_+, V_+ would go down gradually and adjust itself so its equal to V_{in}. Soon V_{out} would ~~start~~ stop decreasing and stabilize. ~~so its 0 as equal to V_+ & V_-.~~

b. $A = 10^4$

$V_{in} = 1V$

$V_{out} = V_+$

$V_{out} = (V_+ - V_-)A$

$V_{out} = (V_{out} - 1)A$

$V_{out} = V_{out}A - A$

$V_{out} - V_{out}A = -A$

$V_{out}(1-A) = -A$

$V_{out} = \frac{-A}{1-A} = \frac{-10^4}{1-10^4} \approx$

$V_{out} = \frac{10^4}{9999} \approx \underline{1V}$

2. a. From voltage divider circuit.

$$V_{fb} = \frac{R_1}{R_1+R_2} \times V_{out}$$

b. We know $V_{in} = V_{fb}$

~~$V_{out} = (V_{in} - V_{fb})A$~~ $V_{in} = \frac{R_1}{R_1+R_2} \times V_{out}$

$$V_{out} = V_{in} \times \frac{R_1+R_2}{R_1}$$

$$\boxed{V_{out} = V_{in} \times \left[1 + \frac{R_2}{R_1}\right]}$$

c. $A_v = \frac{V_{out}}{V_{in}} = \frac{\cancel{V_{out}}}{\frac{R_1}{R_1+R_2} \times \cancel{V_{out}}} = \frac{R_1+R_2}{R_1} = \boxed{1 + \frac{R_2}{R_1} = \frac{V_{out}}{V_{in}}}$

Scanned with CamScanner

d. $A_v = 11$

$R_1 = 10\,k\Omega$

$R_2 = ?$

$$A_v = 1 + \frac{R_2}{R_1}$$

$$11 = 1 + \frac{R_2}{10\times10^3}$$

$$11 = \frac{10\times10^3 + R_2}{10\times10^3}$$

$$11\times10\times10^3 = 10^4 + R_2$$

$$11\times10^4 - 10^4 = R_2$$

$$10^5 = R_2$$

$$R_2 = 100\cancel{0}\,k\Omega$$

3.a. $V_{set} = 2.5\,V$

if $V_{in} = 0\,V$

$$V_{set} = V_{fb}$$

$$V_{out} = \cancel{V_{fb}} - \frac{V_{in} R_2}{R_1}$$

$$V_{out} = V_{set} = 2.5V.$$ since $\frac{0 R_2}{R_1} = 0$.

if $V_{in} = 5V$

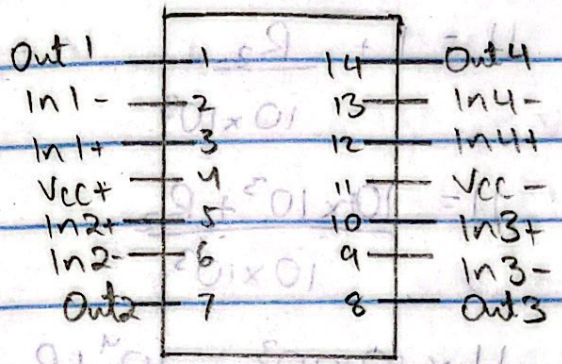
$$V_{out} = \cancel{2.5V} - \frac{5R_2}{R_1}\,V$$

b. The largest ratio would be $3R_2/R_1$, if $V_{in} = 3V$.

c. The largest ratio would be $5R_2/R_1$, if $V_{in} = 5V$.

4. a. There are 4 op amps in the TL974IN.

b.



c. The maximum supply voltage is ~~12~~ 15 V.

d. The minimum voltage is 2.7 V.

e. The power rails can provide voltages greater than 2.7 V, so we can operate this device.

f. The maximum V_{ID} is ± 1 V.

g. I_B typically is 200 - 750 nA. ~~It~~ The device can produce currents upto 1000 nA too over the full range of operating temperatures.

Design Challenge

3. a $V_{out} - V_{fb} = \frac{V_{fb} - V_{in}}{R_1} \times R_2$ $V_{set} = 2.5\,V = V_{fb}$

$R_2 = 30\,k\Omega$

a. $V_{in} = 0$ $V_{out} = 2.5 \times \frac{30 \times 10^3}{50 \times 10^3} + 2.5$ $R_1 = 50\,k\Omega$

$= 4\,V$

b. $V_{in} = 5$ $V_{out} = (2.5-5) \times \frac{30 \times 10^3}{50 \times 10^3} + 2.5$

$V_{out} = 1$

$V_{set} = V_{fb} = 2V$

d. $V_{in} = 5$ $V_{out} = (2-5) \times \frac{30 \times 10^3}{50 \times 10^3} + 2$

$V_{out} = 0.2\,V$

c. $V_{in} = 0$ $V_{out} = 2-0 \times \frac{30 \times 10^3}{50 \times 10^3} + 2$

$V_{out} = 3.2\,V$

e. V_{dd} is 5V.

f. $V_{out} = 4\,V.$ $V_{in} = 0$

$V_{out} = 1\,V.$ $V_{in} = 5$

g. These values might differ if $V_{set} \neq 2.5$. The makes the LED off time, more ~~promin~~ pronouned.

4. As I press the button, I can see the length of the pulses increasing in the oscilloscope. As I turn the potentiometer, the intensity of the LED changes. This changes the range of voltage supplied to the LED. As a result, turning the ~~LED~~ potentiometer to the extreme ends turns off the LED. I can see this as Vout's range rises in the oscilloscope. The light is blinking rapidly which makes it not pleasing.

5. When I attached the capacitor, ~~b~~ the light stopped flickering. The quality of the blinks improved and we can see capacitor charging ~~when~~ before blinks. Like the previous problem, changing the potentiometer changed the intensity of the LED.