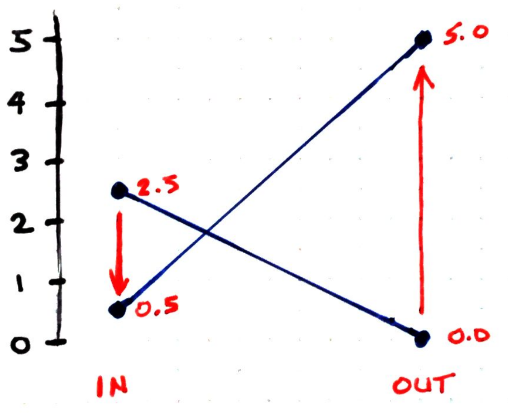
W2AEW

SENSOR SIGNAL CONDITIONING WITH AN OP AMP

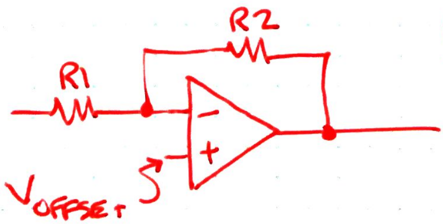
(A PRACTICAL EXAMPLE)

SENSOR OUTPUT		DESIRED OUTPUT
+2.5V	⟶	0V
+0.5V	⟶	5V



A GRAPHICAL VIEW

- A −2V CHANGE AT INPUT → +5V CHANGE AT OUTPUT
  - INVERTING OP GAIN STAGE
    - GAIN = −2.5x



$$\frac{R2}{R1} = 2.5$$

R1 + R2 SELECTION CRITERIA...

- SENSOR OUTPUT IMPEDANCE (LOADING)
- LOAD AT OP AMP OUTPUT
- OTHER FACTORS.

PICK **R1 = 33K**

THEN $R2 = R1 * 2.5$

R2 = 82K

(USING NEAREST STD VALUES)

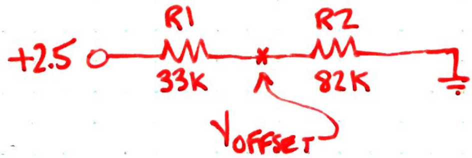
V_{OFFSET}

V_{OFFSET} = VOLTAGE NEEDED AT NON-INVERTING INPUT TO SHIFT O/P UP TO DESIRED RANGE

- GRAPH GIVES THE VALUE!
- OR - SIMPLE CALCULATION...
  - CONSIDER ONE OF THE STATES

    2.5V IN → 0V OUT

  - SIMPLE VOLTAGE DIVIDER



$$\frac{(2.5V)\,R2}{R1+R2} = V_{OFFSET}$$

$V_{OFFSET} = 1.78V$

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FINISH DESIGN DETAILS

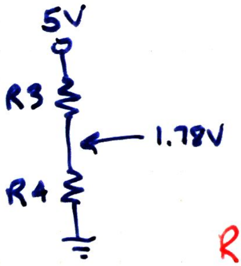
Vcc = 5V

- NEED SINGLE-SUPPLY OP AMP WITH RAIL-RAIL OUTPUT SWING
- INPUT COMMON-MODE INCLUDES 1.78V

- USING **MCP6002**
  - VSUPPLY MAX 6V
  - R-R INPUT + OUTPUT
  - DIP PACKAGE

GENERATE $V_{OFFSET} = 1.78V$

- USE RESISTOR DIVIDER



$V_{R3} = 5 - 1.78 = 3.22$

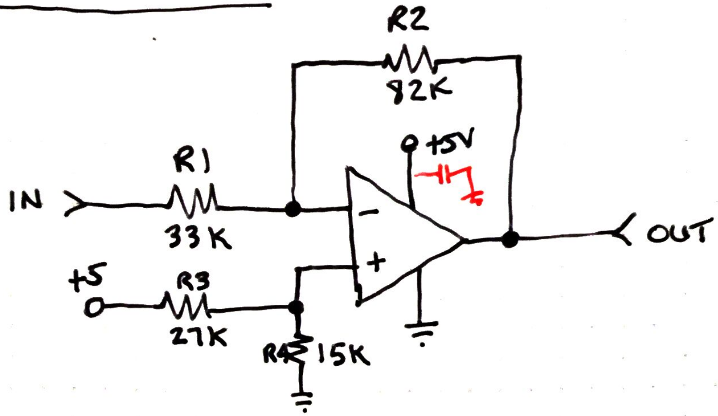
$V_{R4} = 1.78$

$$\frac{R3}{R4} = \frac{V_{R3}}{V_{R4}} = \frac{3.22}{1.78} = 1.8$$

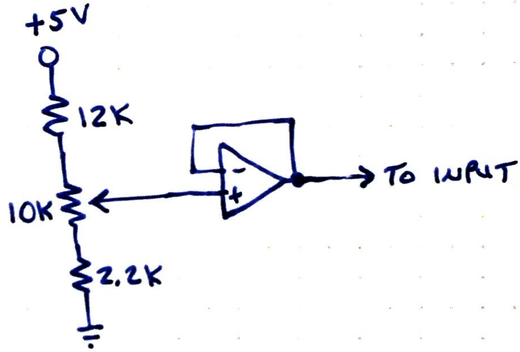
PLAY WITH STD VALUES...

R3 = 27K
R4 = 15K

FINAL CIRCUIT



SIMULATE SENSOR WITH...



FINAL THOUGHTS

- POWER SUPPLY DECOUPLING (ALWAYS)
- TRIMMERS TO TRIM GAIN + V_{OFFSET}
- INPUT CURRENT CONSIDERATIONS
- INPUT OFFSET TRIMMING