3 Resistor Network Cheat Sheet

Design:

To map voltage $[V_{IL}:V_{IH}]$ into voltage $[V_{OL}:V_{OH}]$:

Voltage gain $A = \dfrac{V_{IH} - V_{IL}}{V_{IH} - V_{IL}}$

Choose input resistor R_1

Find Thévenin equivalent voltage of remaining two resistors:

$$V_{Th} = \frac{V_{OL} - AV_{IL}}{1 - A}$$

Find Thévenin equivalent resistance of remaining two resistors

$$R_2 \| R_3 = \frac{AR_1}{1 - A}$$

Find divider ratio of remaining two resistors:

$$B = \frac{V_{Th} - V_{ee}}{V_{cc} - V_{ee}}$$

Find remaining two resistors:

$$R_2 = \frac{R_{Th}}{B} \quad ; \quad R_3 = \frac{R_{Th}}{1 - B}$$

Analysis:

Output resistance:

$$R_{out} = \frac{1}{1/R_1 + 1/R_2 + 1/R_3}$$

Open-circuit output voltage:

$$V_{out} = \frac{\dfrac{V_{in}}{R_1} + \dfrac{V_{cc}}{R_2} + \dfrac{V_{ee}}{R_3}}{\dfrac{1}{R_1} + \dfrac{1}{R_2} + \dfrac{1}{R_3}}$$