

LAST TIME CH. 28

OP AMPS
NEGATIVE FEEDBACK
GOLDEN RULES

TODAY CH. 29 (THROUGH P. 260)

REVIEW GOLDEN RULES
LOTS OF EXAMPLES
ADDITION & SUBTRACTION OF SIGNALS
I-V CONVERTER
ETC.

COMPAD

GOLDEN RULES REVIEW

ASSUMPTIONS:

- IDEAL OP AMP
- ASSUME NOT SATURATED ($-V_s < V_{out} < V_s$, WITH MARGIN)
- NEGATIVE FEEDBACK

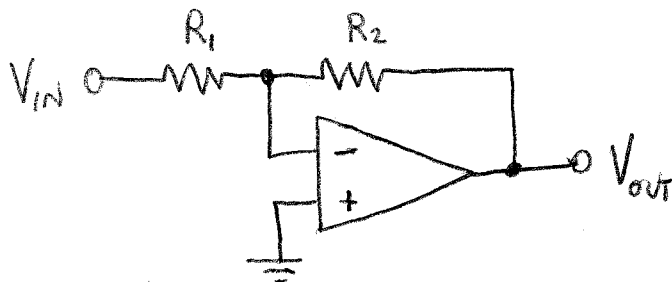
I. $V_+ = V_-$

II. $i_+ = i_- = 0$

EVERY CIRCUIT IN CH. 28 IS
AN APPLICATION OF THESE RULES.

Discuss: How
does each
Golden Rule
build on the
assumptions?

Always start by asking: Do the Golden Rules apply?

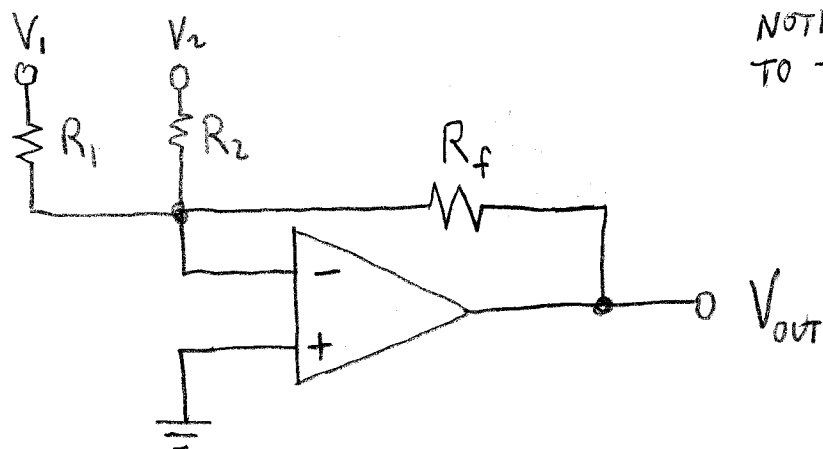
INVERTING AMPLIFIER (FAISSLER CH. 28)

$$V_+ = V_- = 0$$

$$\frac{V_{IN} - 0}{R_1} + \frac{V_{OUT} - 0}{R_2} = 0$$

$$V_{OUT} = -\frac{R_2}{R_1} V_{IN}$$

BY THE WAY, THE RELATIONSHIP THAT GIVES
A CIRCUIT'S OUTPUT(S) IN TERMS OF ITS
INPUT(S) IS CALLED A TRANSFER FUNCTION.

INVERTING ADDER

NOTICE THE SIMILARITY
TO THE INVERTING AMP!

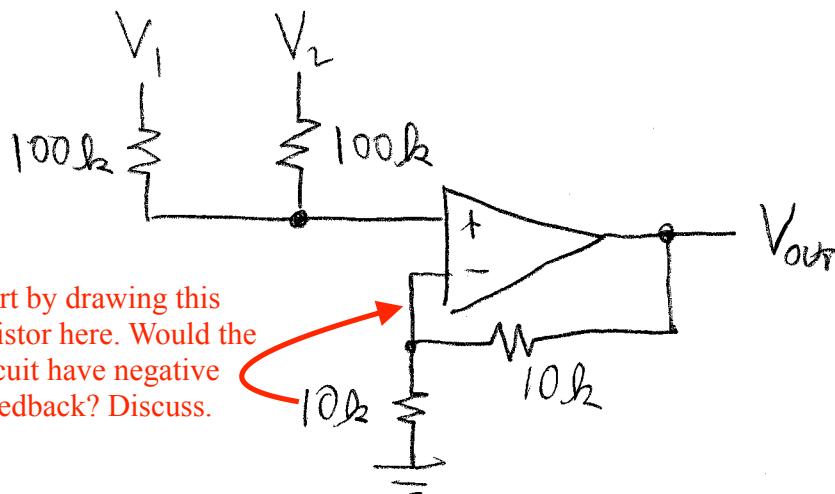
AS WITH THE INVERTING AMP,

$$V_+ = V_- = 0.$$

KCL: $\frac{V_1 - 0}{R_1} + \frac{V_2 - 0}{R_2} + \frac{V_{out}}{R_f} = 0$

$$V_{out} = -\frac{R_f}{R_1} V_1 - \frac{R_f}{R_2} V_2$$

AN ADDER THAT DOES NOT INVERT:



NVA:
$$\frac{V_1 - V_+}{100k} + \frac{V_2 - V_+}{100k} = 0$$

$$\Rightarrow V_+ = \frac{1}{2}(V_1 + V_2)$$

$$\frac{V_{out} - V_-}{10k} + \frac{0 - V_-}{10k} = 0 \quad (\text{or use voltage divider formula!})$$

$$\Rightarrow V_{out} = 2V_-$$

SINCE $V_+ = V_-$,

$$\boxed{V_{out} = V_1 + V_2}$$