Lecture 4 : Push-Pull Output Stage

(Quiz)

0. Review
1. Push-Pull Stage
2. Push-Pull Design

- Quiz today
- PreLab 2 due at lab session
- HW2 due Fri (Sep 27)
- Lab1 report due next Wed (Oct 01)
  - ⇒ See course website for template

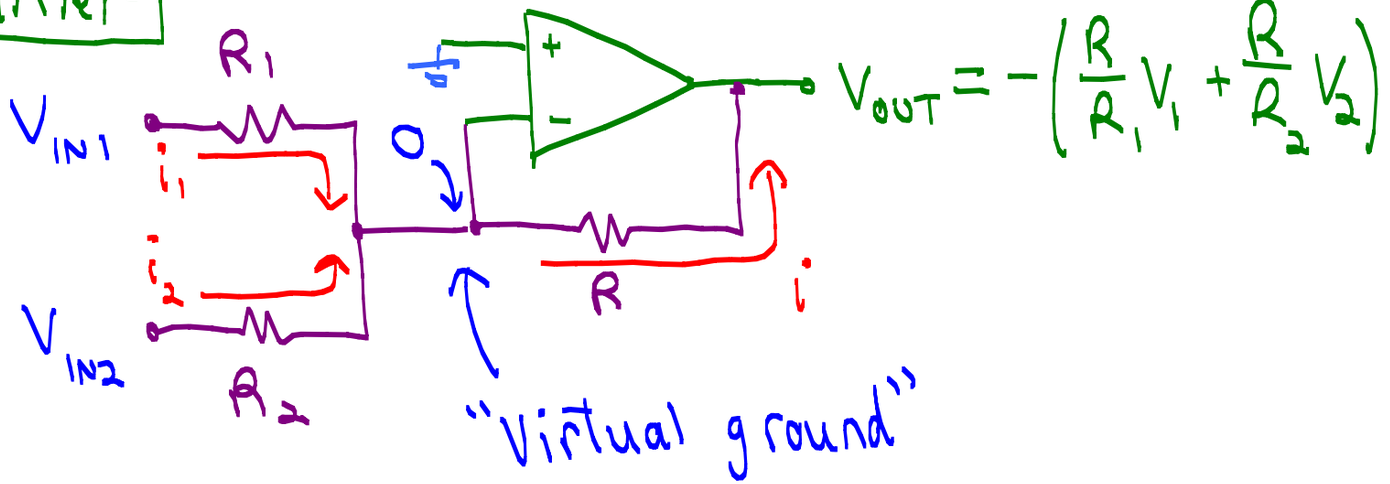
Textbook reading: 16-2 The 741 Op Amp
16-3 The Inverting Amplifier
16-5 Two op Amp applications
18-7 Current Boosters

0. Review

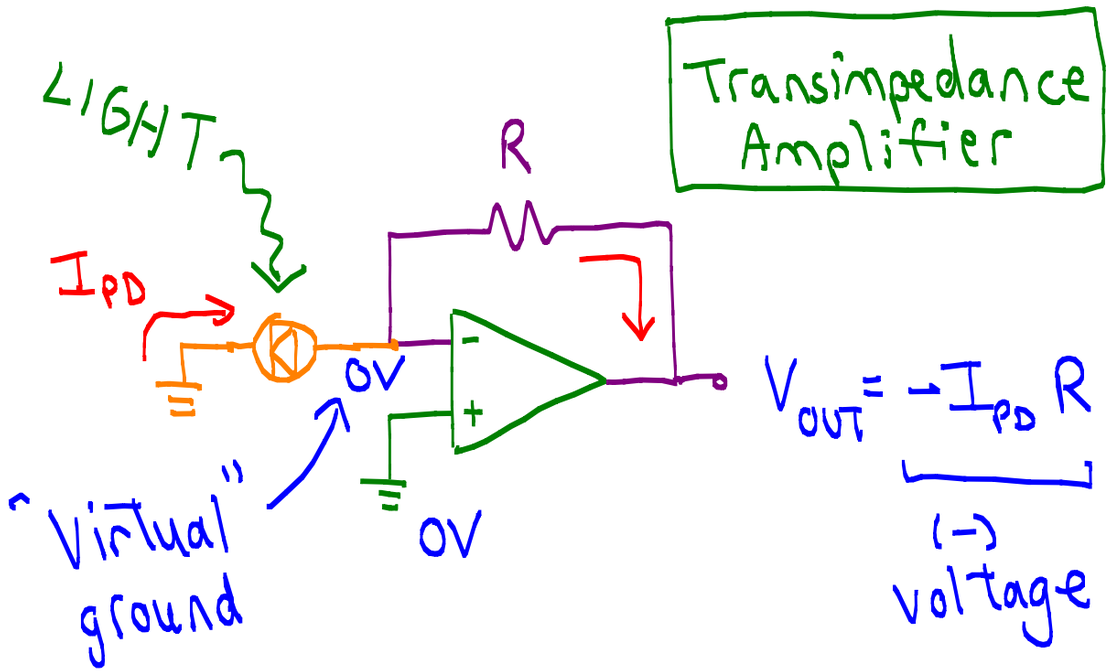
Op Amp Golden Rules:

1. $V_{IN+} = V_{IN-}$ ← "virtual short"
2. Zero input current

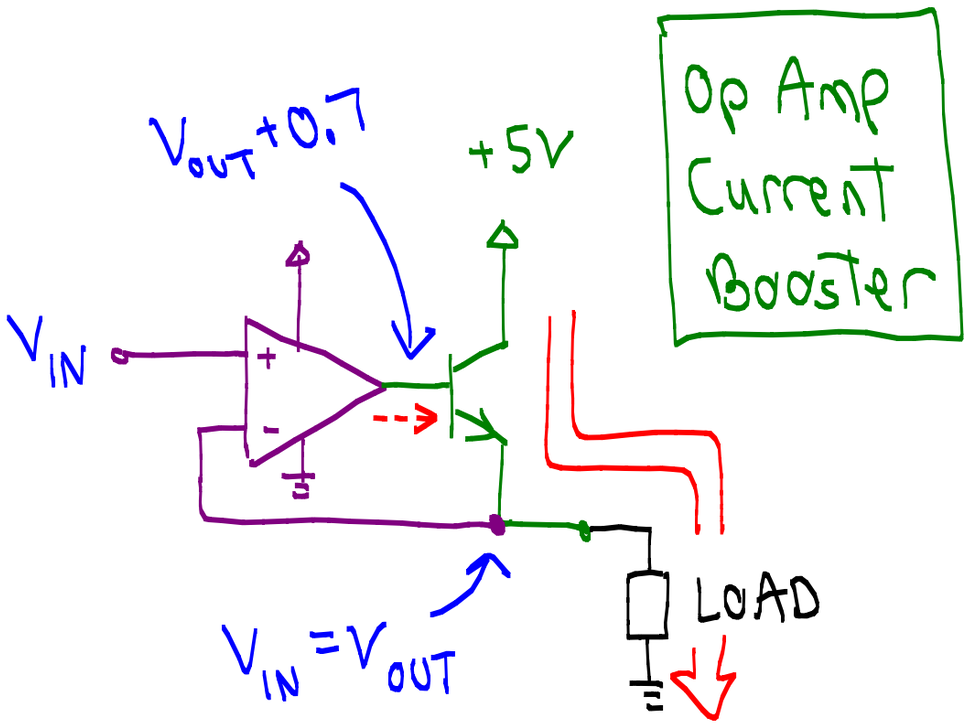
Summing Amplifier



Transimpedance Amplifier

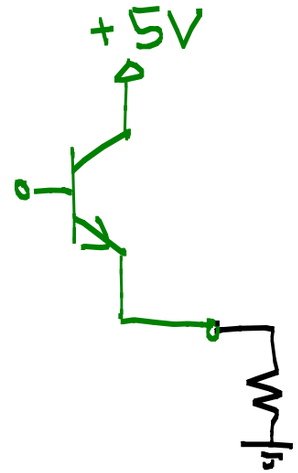


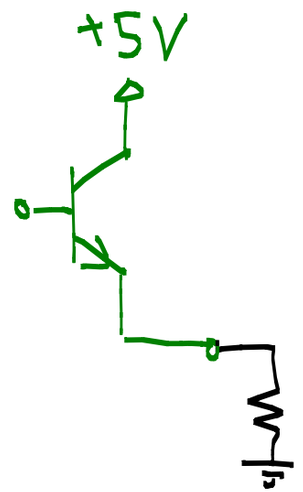
Op Amp Current Booster



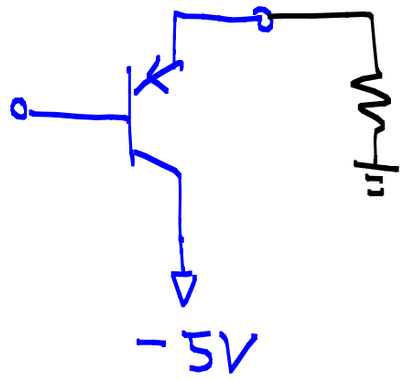
1. Push-Pull Stages

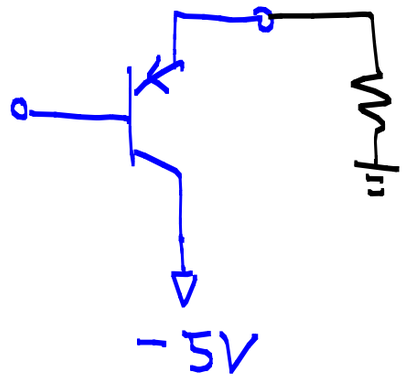
- An npn follower can only





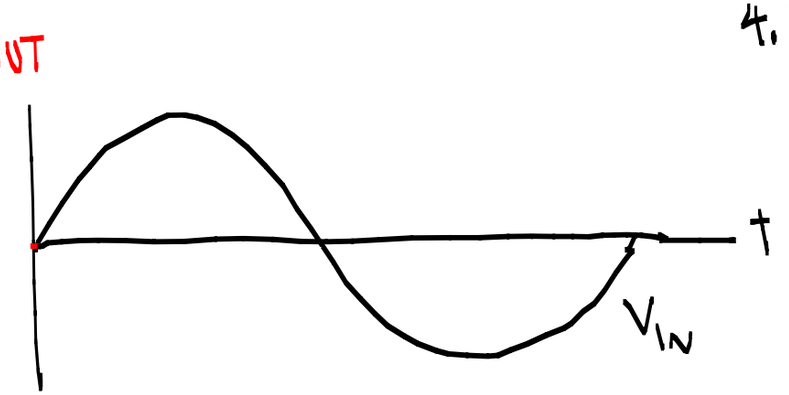
- A pnp follower can only

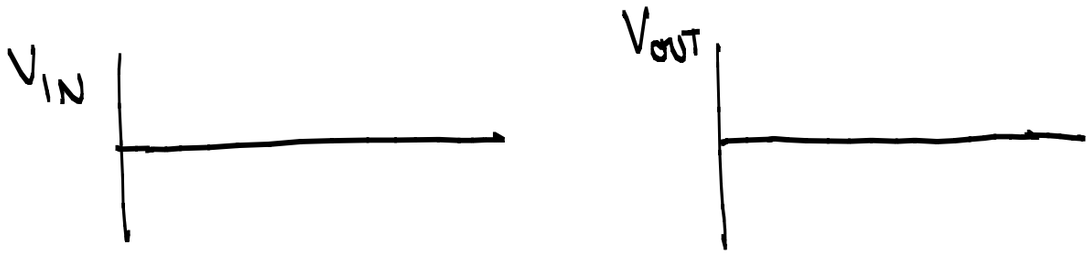


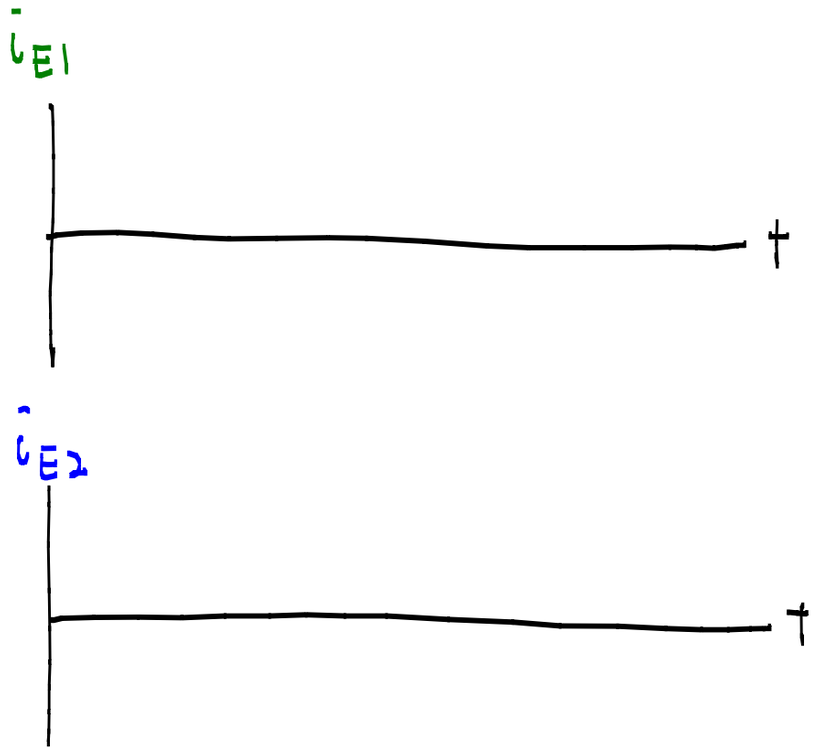


☆ Called a "_____" "or" "stage

Is there a catch? Unfortunately, YES. ☹

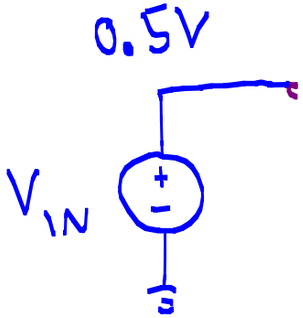


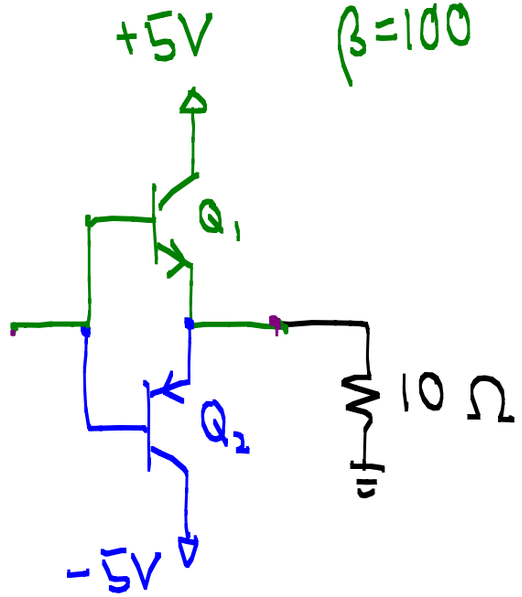


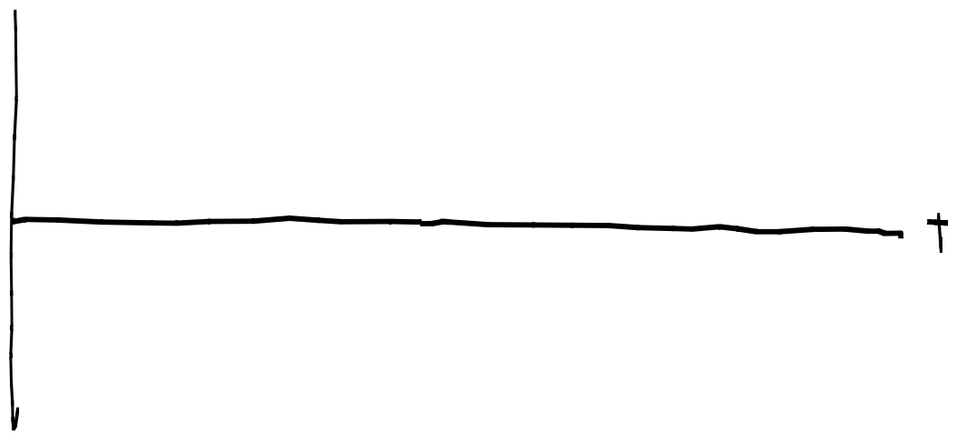


One way to reduce crossover distortion is to use the push-pull with

Example







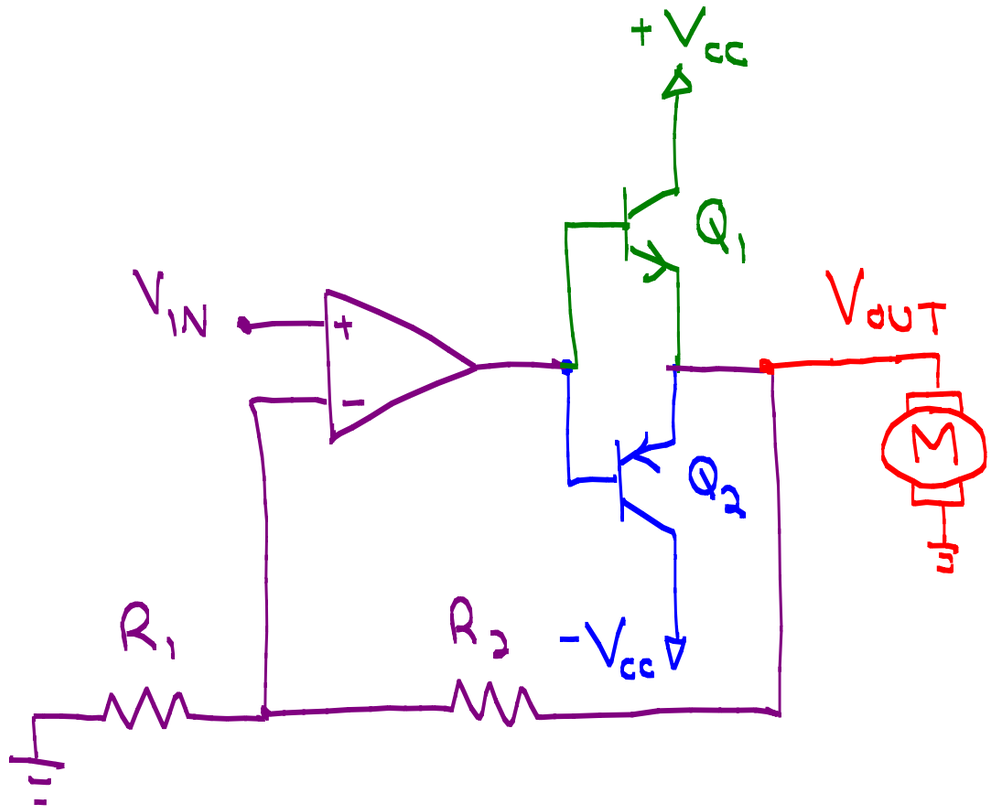
2. Push-Pull Design

Example: Motor driver
- ±9V max
- 2W max
- Gain = 20 ± 5%

↑ We'll use "worst case" parameters for this example.

V_{cc} = 9, 12, 15, or 18V

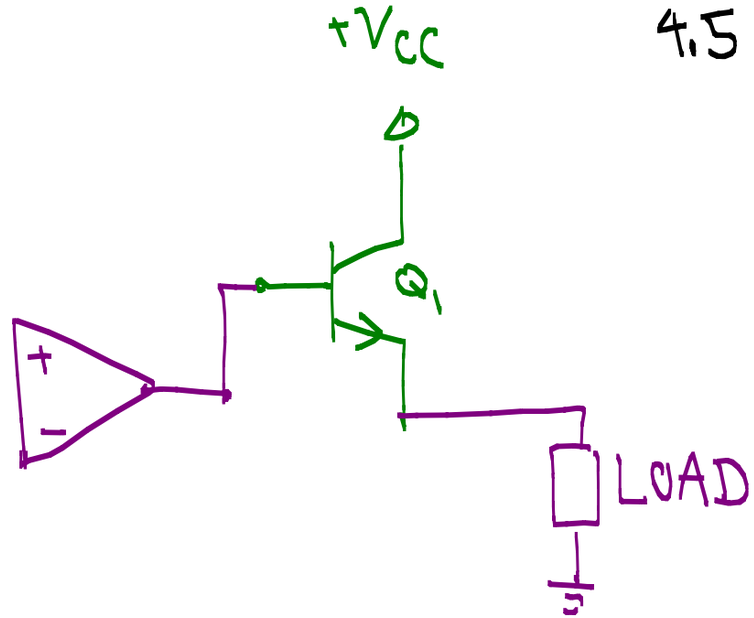
①



② Choose V_{cc}

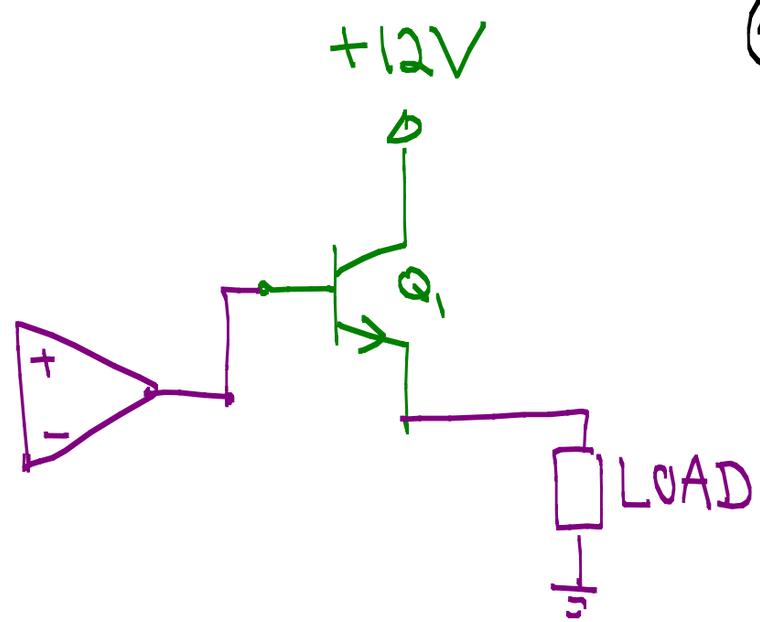
Make sure Q_1 _____ ?

★ We want



③ Choose Transistor

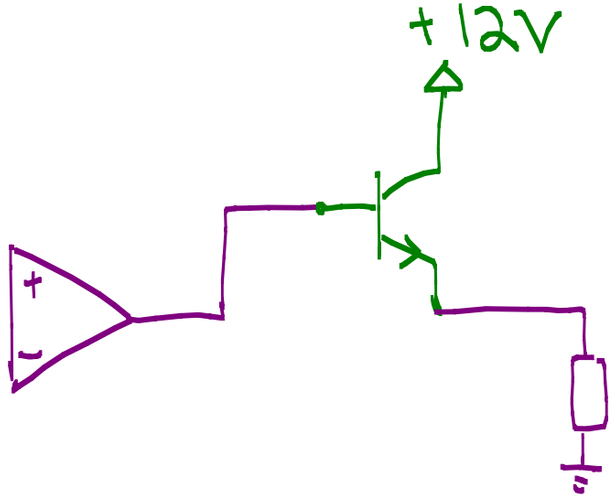
Demanded by circuit:



Q_1	Max I_C	Max V_{CE}	(no HS) P_{Rating}	(w/HS) P_{rating}
2N3904				
2N4401				

④ Max op amp output OK?

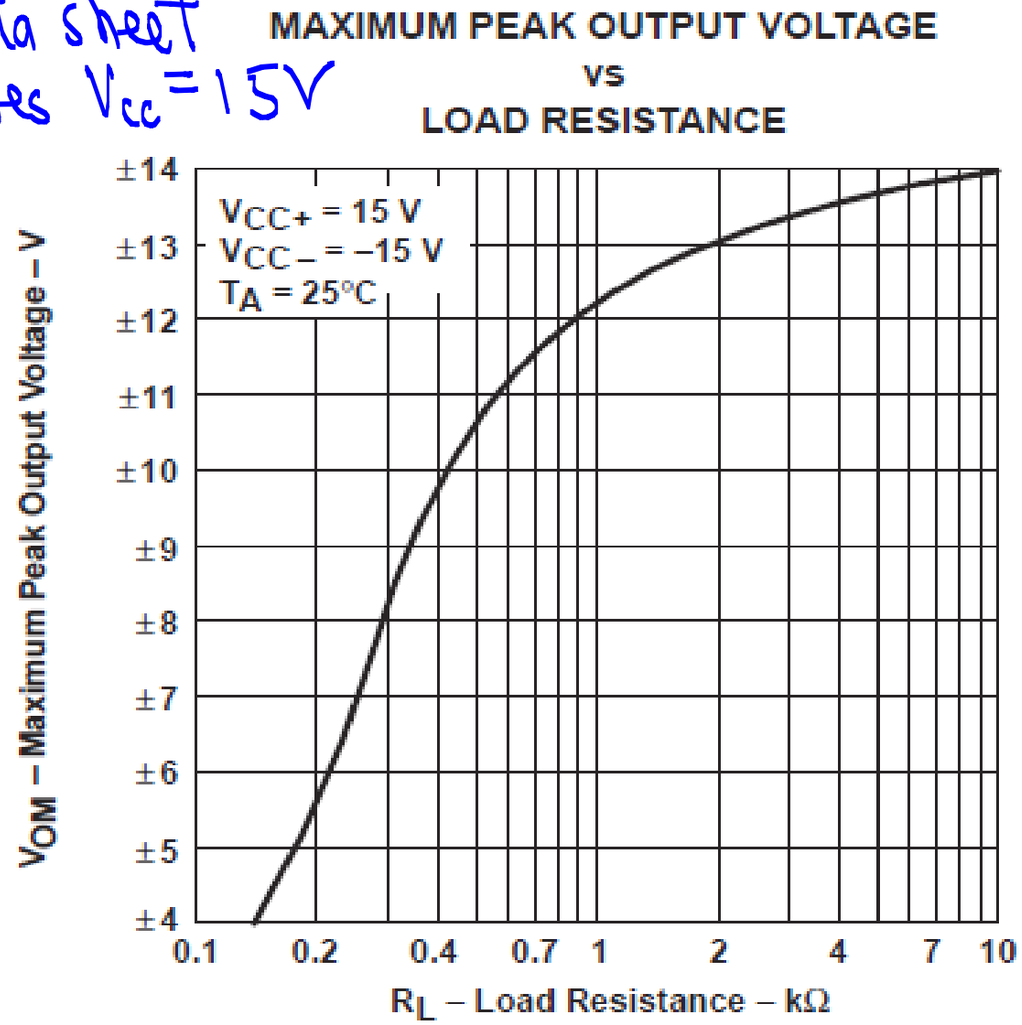
Data sheet uses $V_{cc} = 15V$



See appendix:

Min β

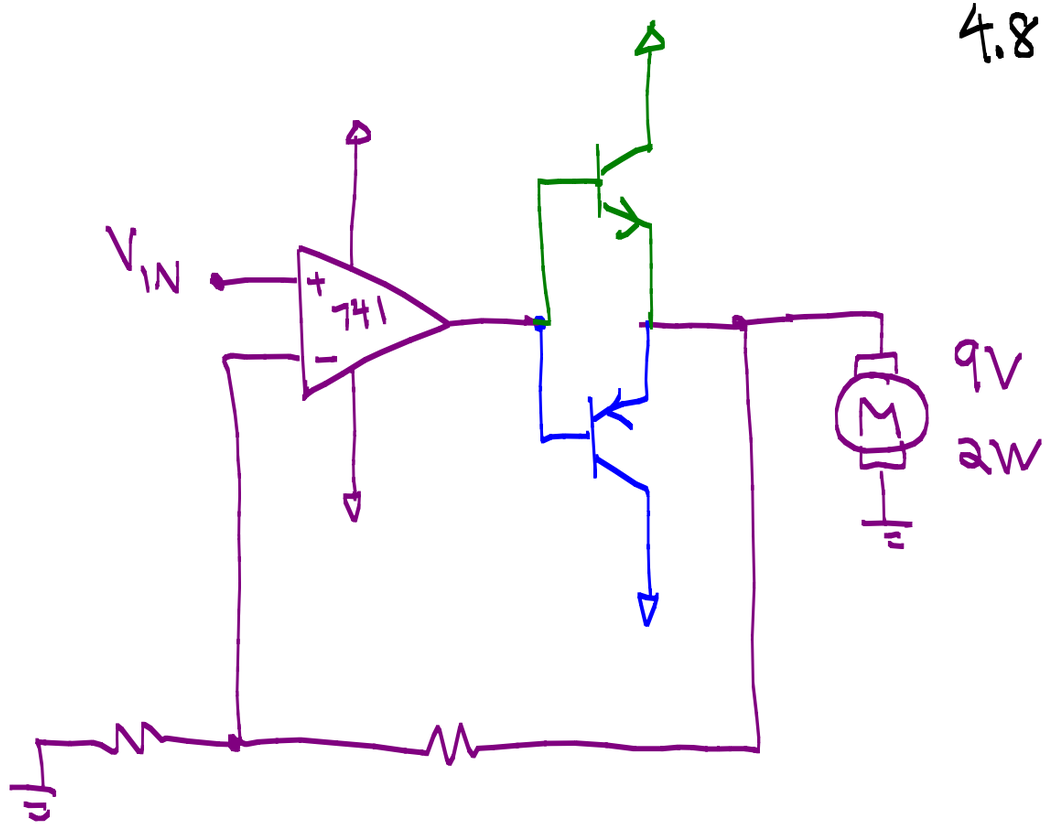
V_{BE}



Q: Can op amp output

⑤ Compute heat sink:

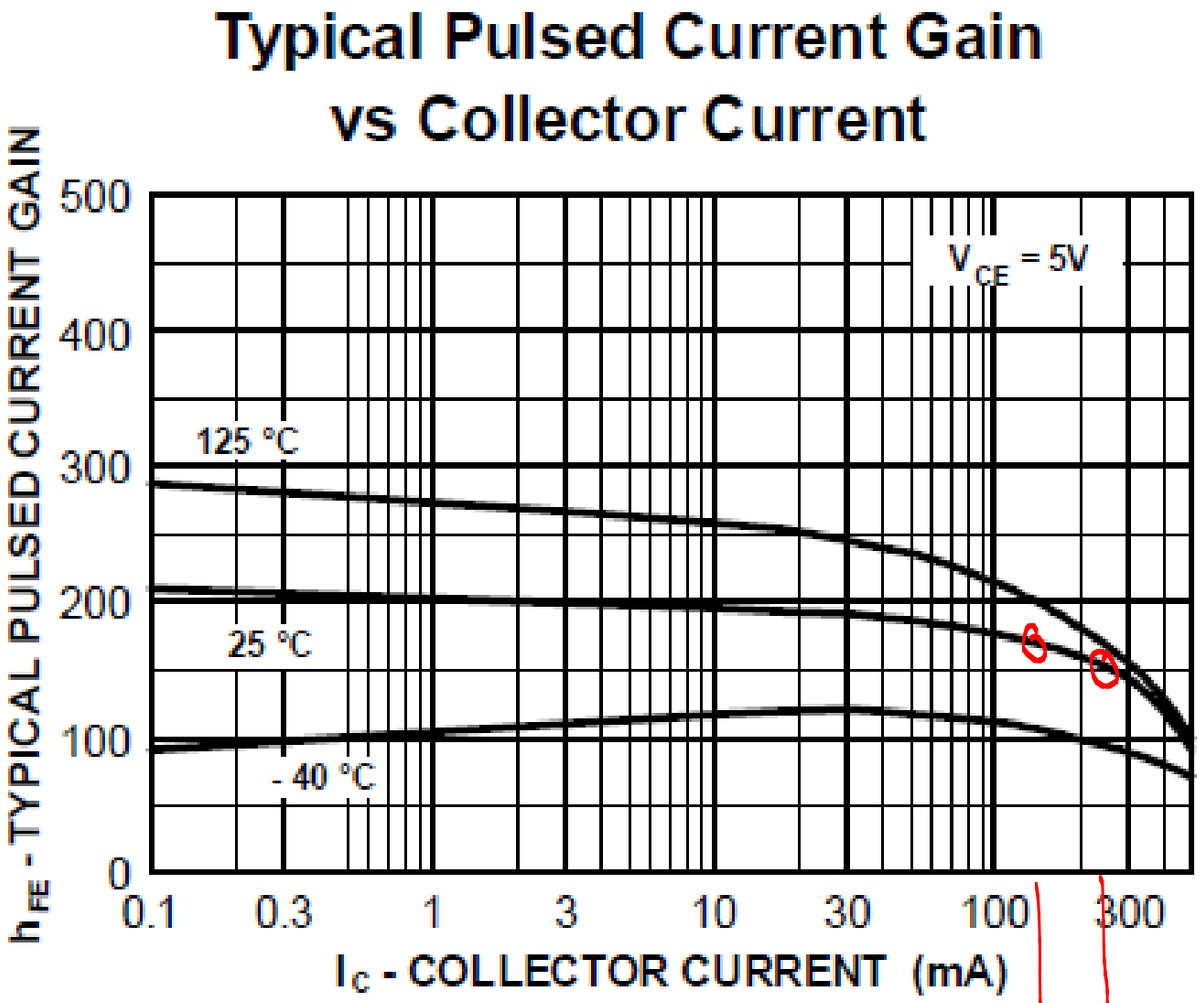
★ Find Θ_{SA}



- Op amp feedback resistors?

Appendix

2N4401 data sheet (Fairchild)

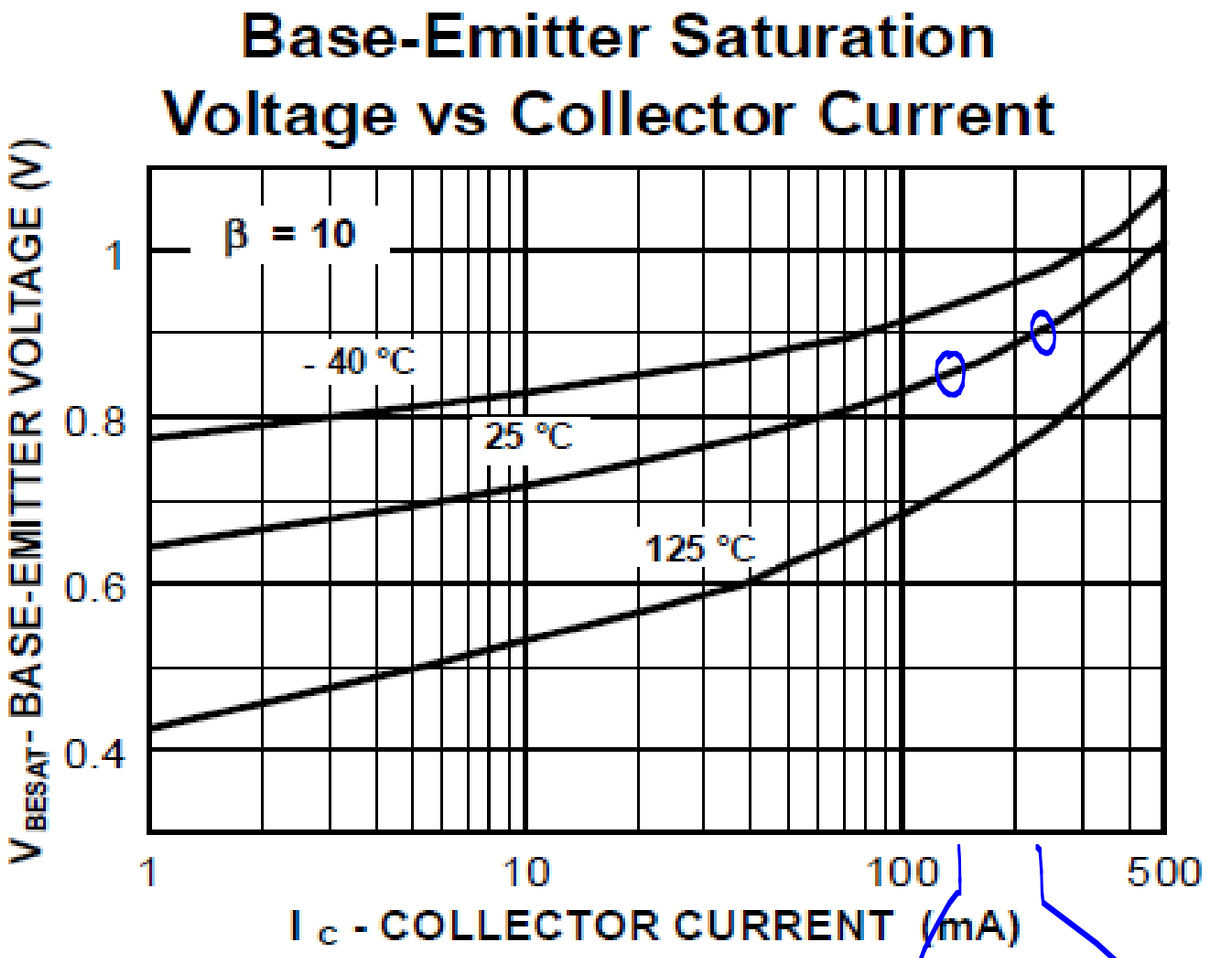


$\frac{\beta_{typ}}{\beta_{min}}$

150 mA

~222 mA

✡ V_{BE} increases with I_C



Typical V_{BE}

Max V_{BE}

150mA

222mA