E151 Lecture 25 – Wrap Up

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ENGR151

Disclaimer

These are notes for Prof. Spencer to give the lecture, they were not intended as a reference for students. Students asked for them anyway, so I'm putting them up as a courtesy. Remember that they are not intended as a substitute for attending lecture.

Administrative

- Assessment – in class right now, out of class as final review
- Final is Monday 5/11, 2-5PM. Allowed 2 8.5”x11” cheat sheets.
  (More details to follow in email, including review resoruces & Zoom)
- We’re going to fill out course evaluations today.

Stability Analysis Practice

- Consider an uncompensated amplifier with two poles at p1=1MHz and p2=10MHz. What is the maximum open loop gain the amplifier can have and still be unity gain stable?

- Answer:
  - reach 180deg phase at 100MHz.
  - Have 1 decade (1MHz-10MHz) of 20dB rolloff
  - Have 1 decade (10MHz-100MHz) of 40dB rolloff
  - Therefor max stable gain is 60dB → 1000

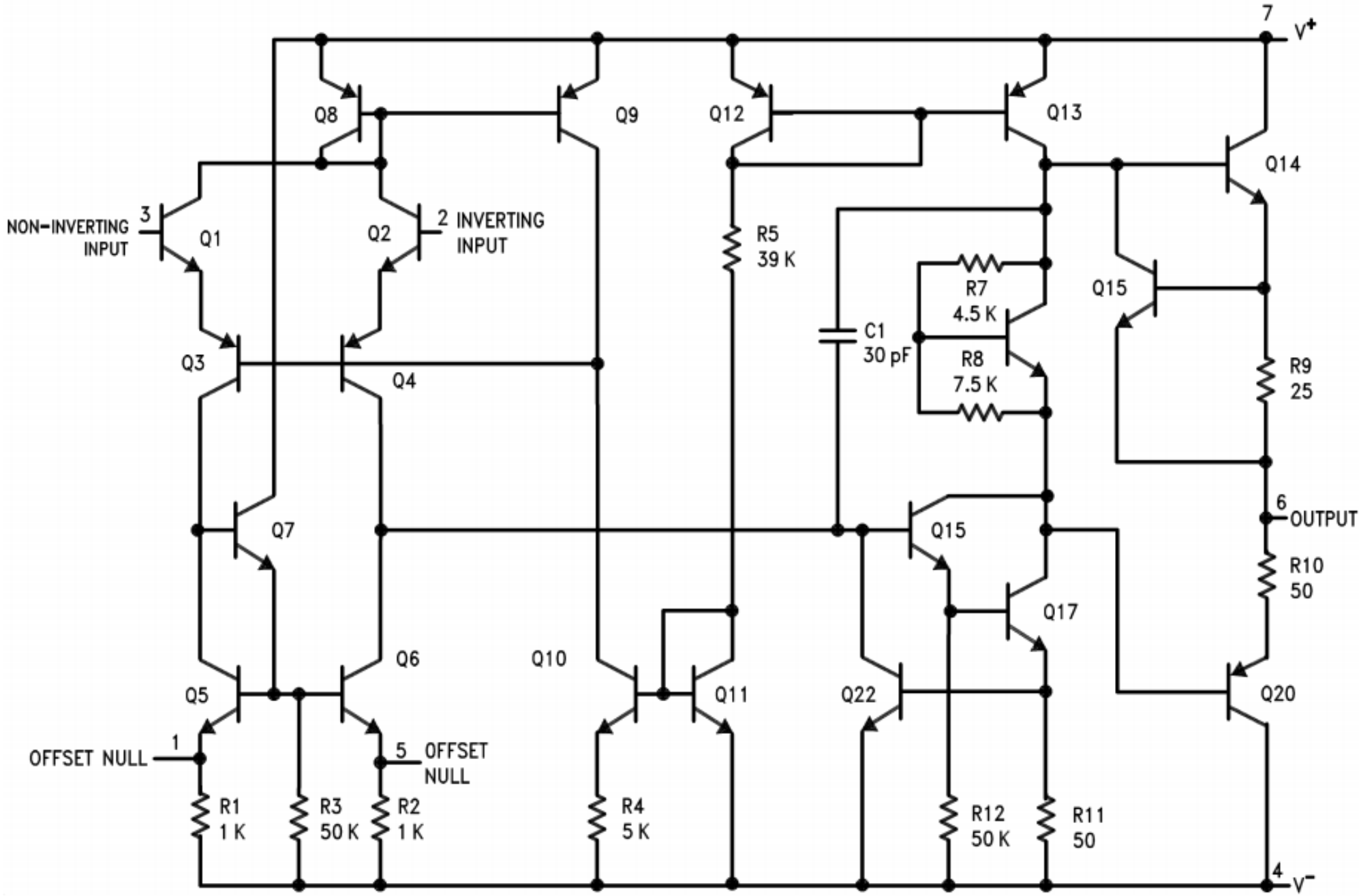
Stability Analysis Practice, Round 2

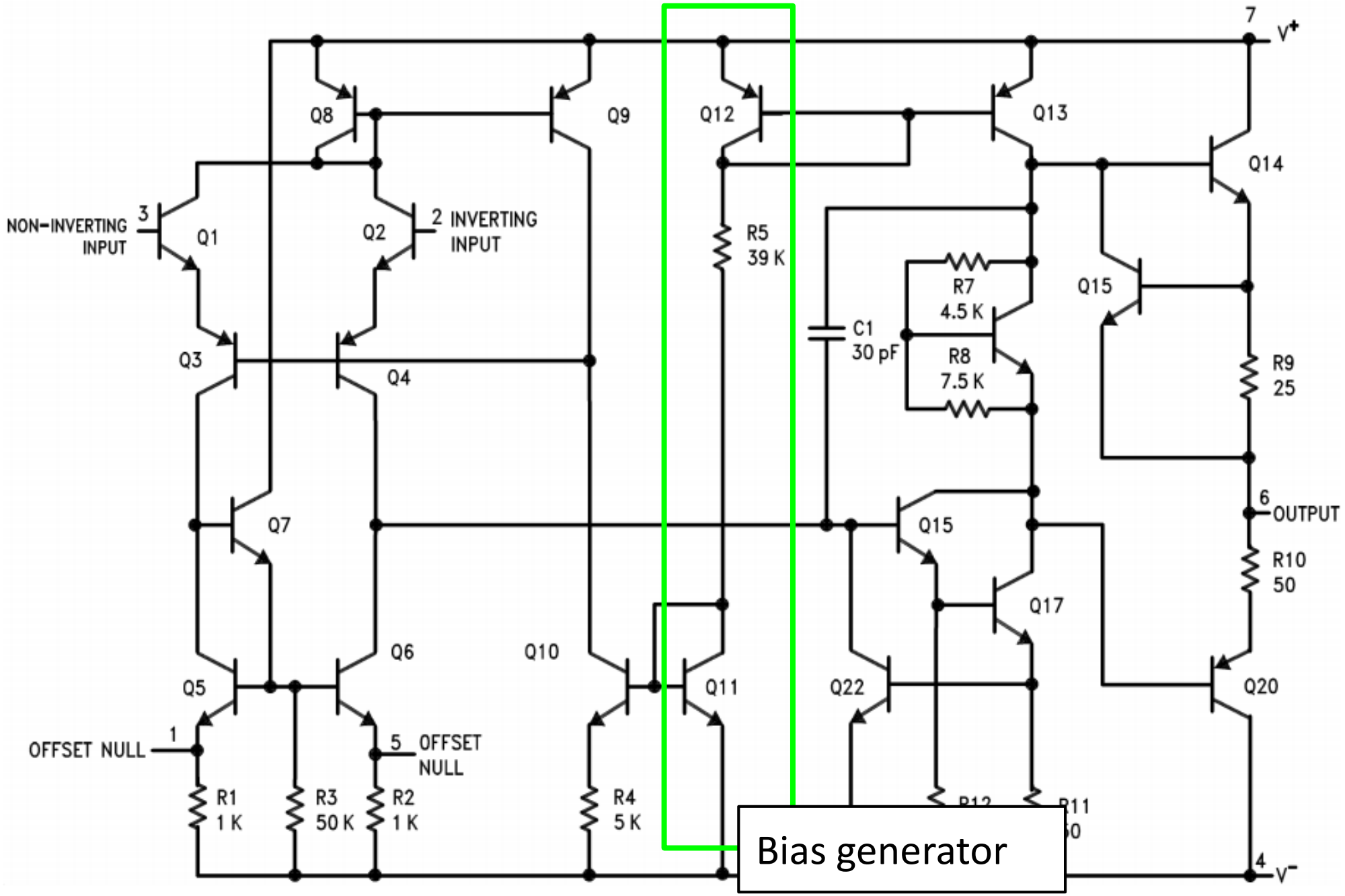
- Consider an uncompensated amplifier with two widely separated poles. One at low frequency and the second at crossover. What is the phase margin of this amplifier?

- Answer:
  - Leave as exercise to reader

Op-Amp Quiz Follow Up

- Output and input swing calculations may be rusty, esp class B/AB
- Bandwidth and/or transfer function estimation is a good skill
  - Usually only need to find one OCTC or calculate rout into Ccomp,eff
- Natural followup would be to use Xfer function to ask about stability
- DC coupling didn’t require a level shift here
- Must degenerate CE stage because emitter bypass doesn’t work at DC
- rin of the class AB is small … careful of loading


7
V+
Q8
Q9
Q12
Q13
Q14
NON-INVERTING INPUT
3
Q1
Q2
2
INVERTING INPUT
R5
39 K
R7
4.5 K
Q15
C1
30 pF
R8
7.5 K
R9
25
Q3
Q4
6
OUTPUT
Q7
Q15
R10
50
Q17
Q10
Q6
Q5
Q11
Q22
Q20
OFFSET NULL
1
5
OFFSET NULL
R1
1 K
R3
50 K
R2
1 K
R4
5 K
R12
50 K
R11
50
4
V-


7
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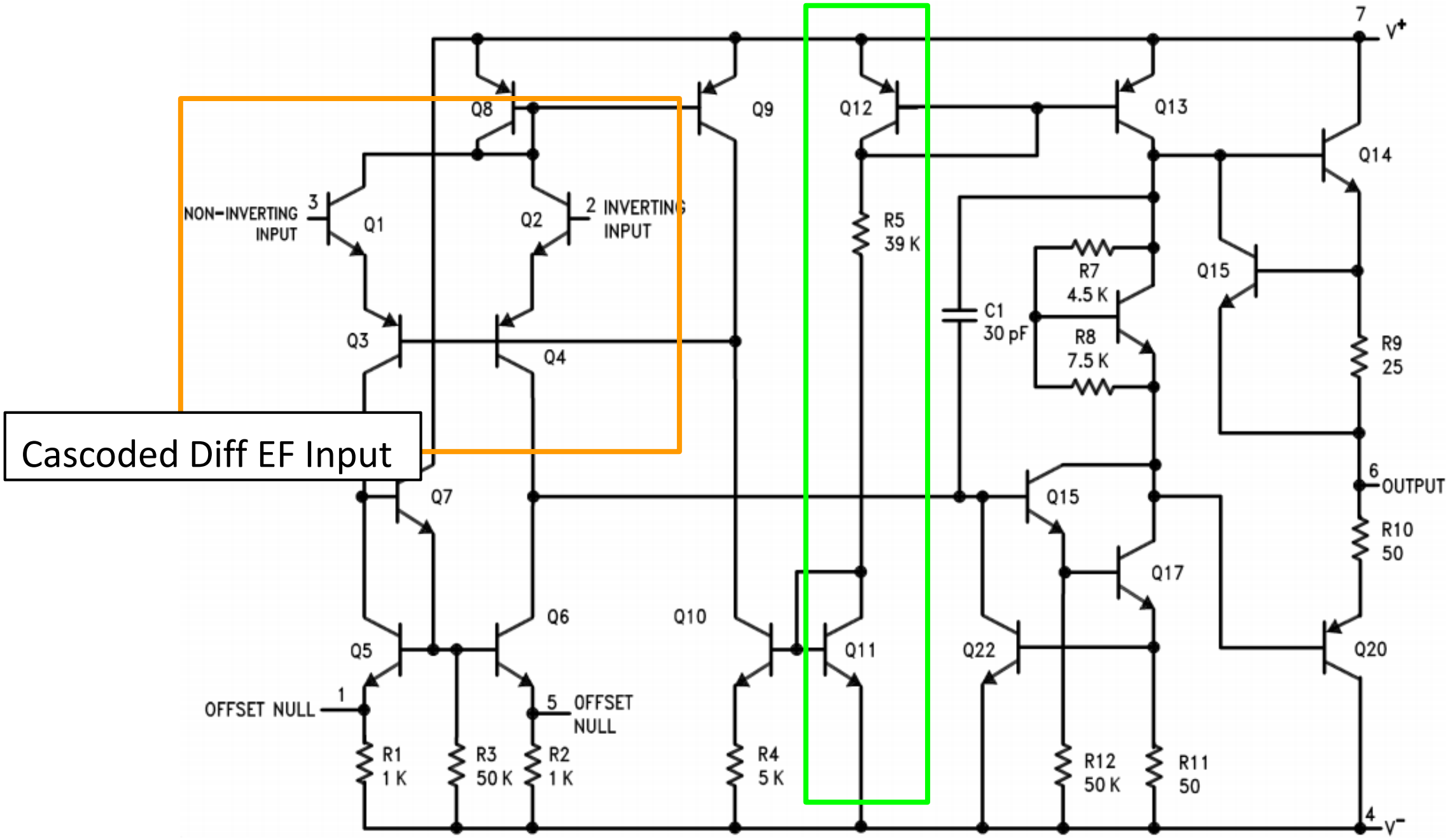
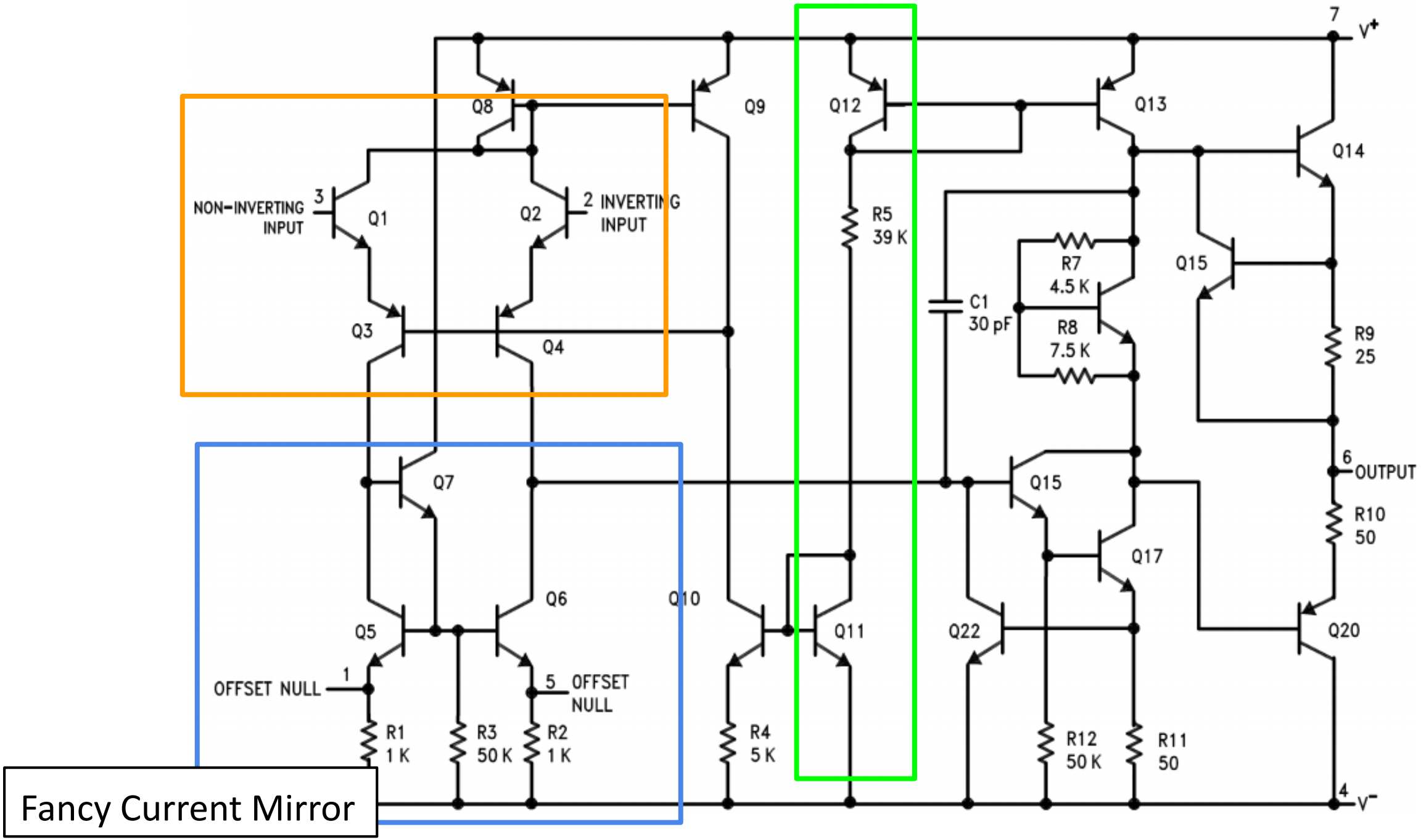
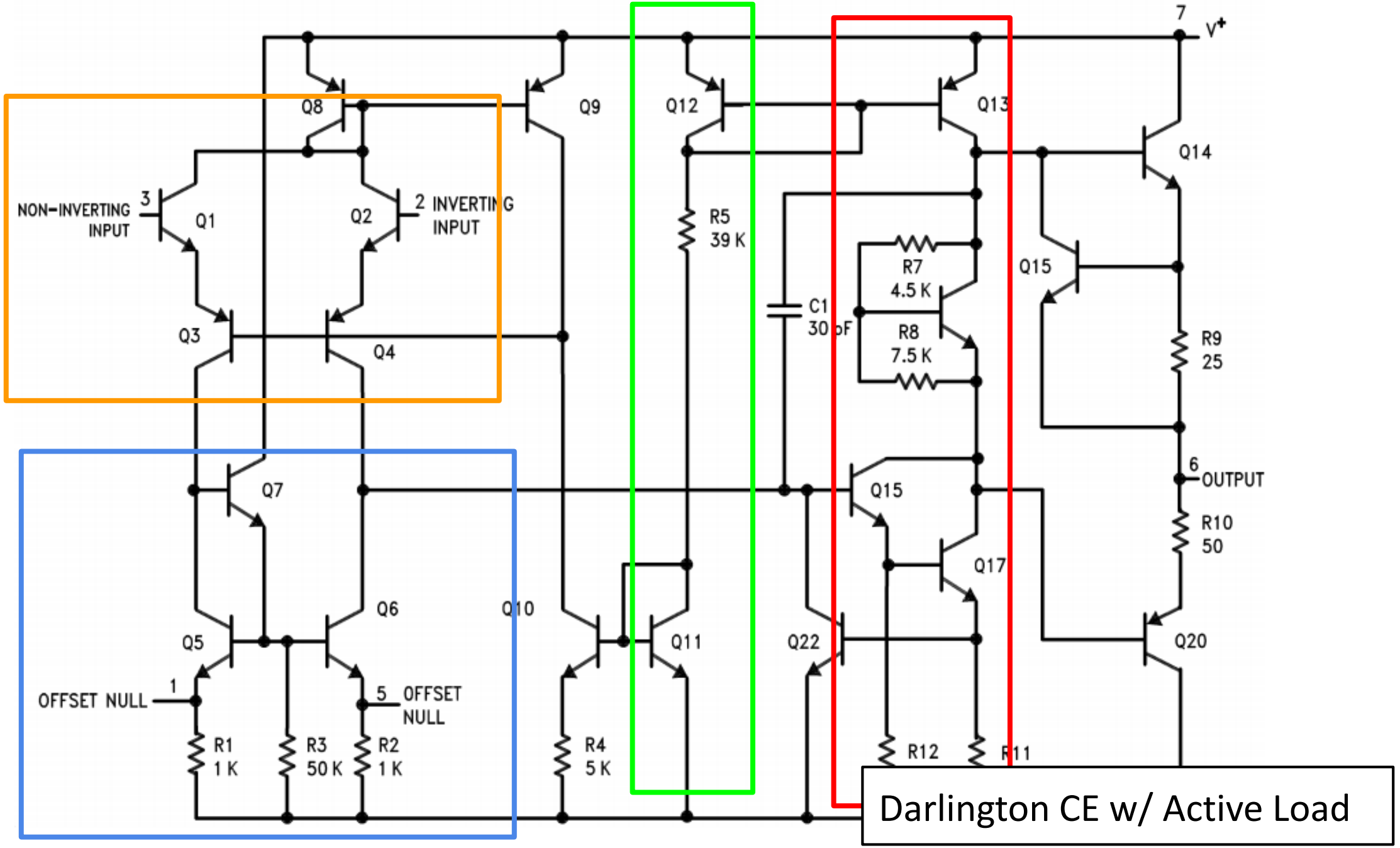
Q6
Q10
Q11
Q22
Q20
Q5
1
OFFSET NULL
5
OFFSET
NULL
R1
1 K
R3
50 K
R2
1 K
R4
5 K
R12
R11
4
V-
Bias generator

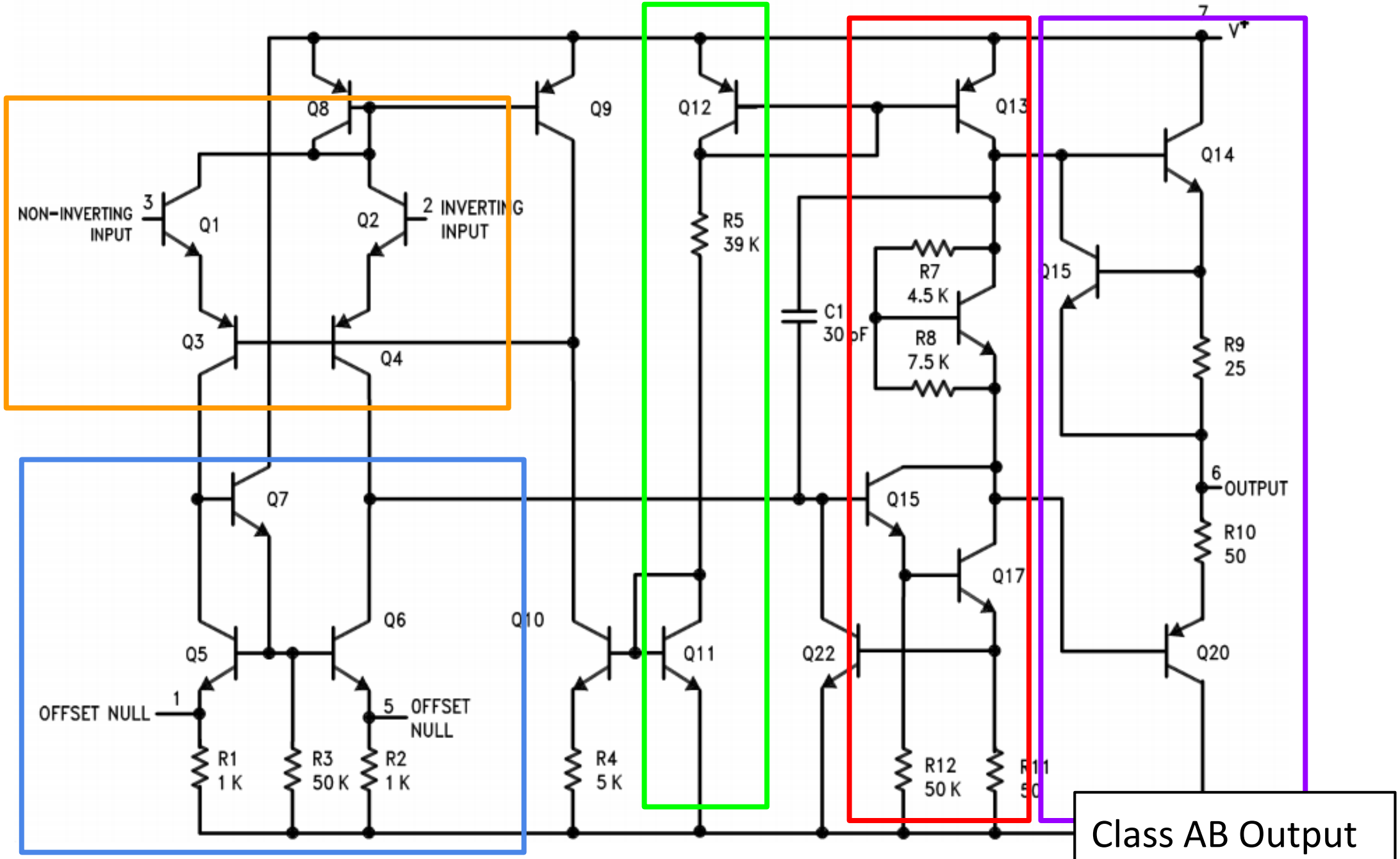

Cascoded Diff EF Input
NON-INVERTING INPUT
3
Q1
Q2
2
INVERTING INPUT
Q3
Q4
Q7
Q8
Q9
Q12
Q13
Q14
Q15
Q5
Q6
Q10
Q11
Q22
Q17
Q20
OFFSET NULL
1
5
OFFSET NULL
R1 1 K
R3 50 K
R2 1 K
R4 5 K
R5 39 K
R7 4.5 K
R8 7.5 K
C1 30 pF
R9 25
R10 50
R12 50 K
R11 50
7
V+
6
OUTPUT
4
V-



Fancy Current Mirror



Darlington CE w/ Active Load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Q13
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V+
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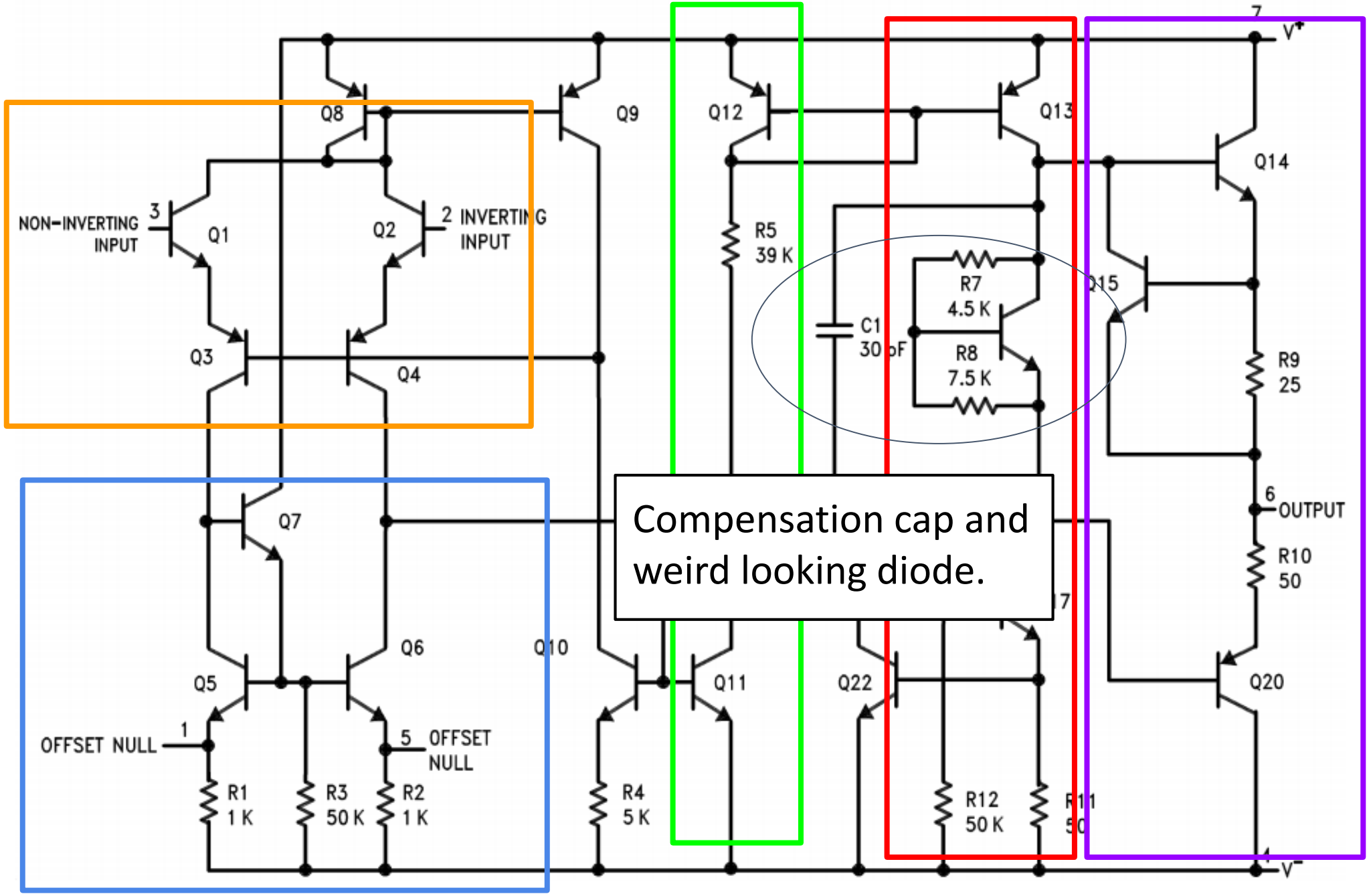
7.5 K
R9
25
6
OUTPUT
R10
50
Q7
Q6
Q10
Q5
Q11
Q22
Q15
Q17
Q20
OFFSET NULL
1
5 OFFSET NULL
R1
1 K
R3
50 K
R2
1 K
R4
5 K
R12
50 K
R11
50
Class AB Output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Q9
Q12
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Q14
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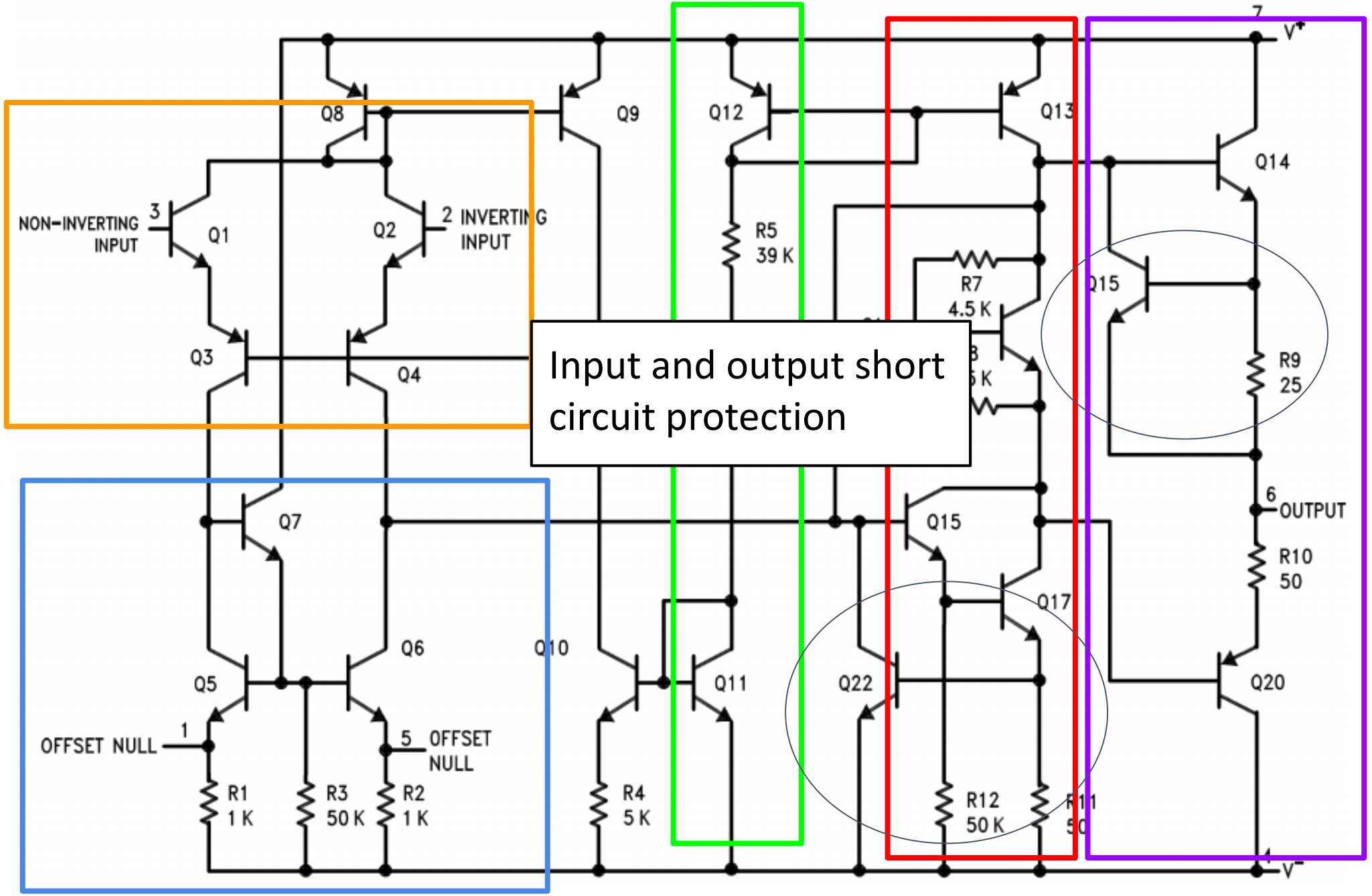
R7 4.5 K
R8 7.5 K
C1 30 pF
R9 25
R10 50
6 OUTPUT
7 V+
4 V-
Q7
Q6
Q5
Q10
Q11
Q22
Q20
OFFSET NULL
1
5 OFFSET NULL
R1 1 K
R3 50 K
R2 1 K
R4 5 K
R12 50 K
R11
Compensation cap and weird looking diode.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4
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Input and output short circuit protection