EE2 Circuits and Systems

Revision Lecture

Lab 1 & 2 Explained

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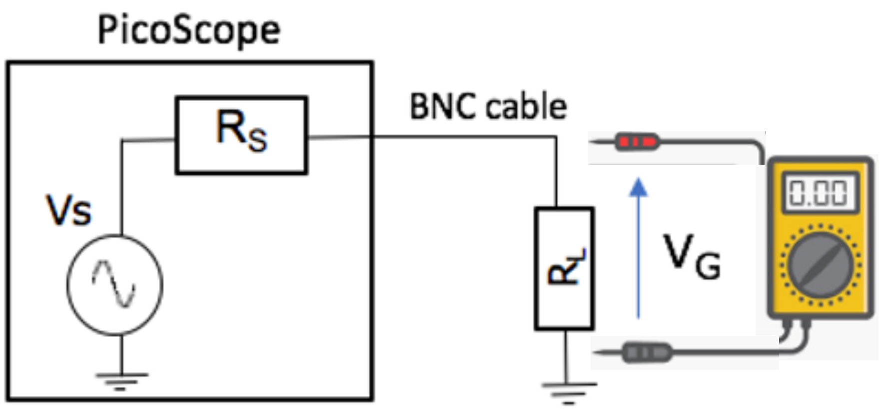
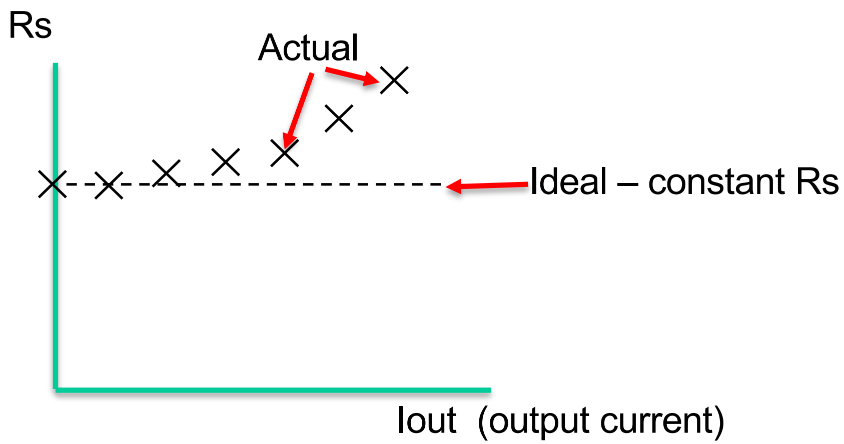
Task 1 – Output impedance of PicoScope SigGen

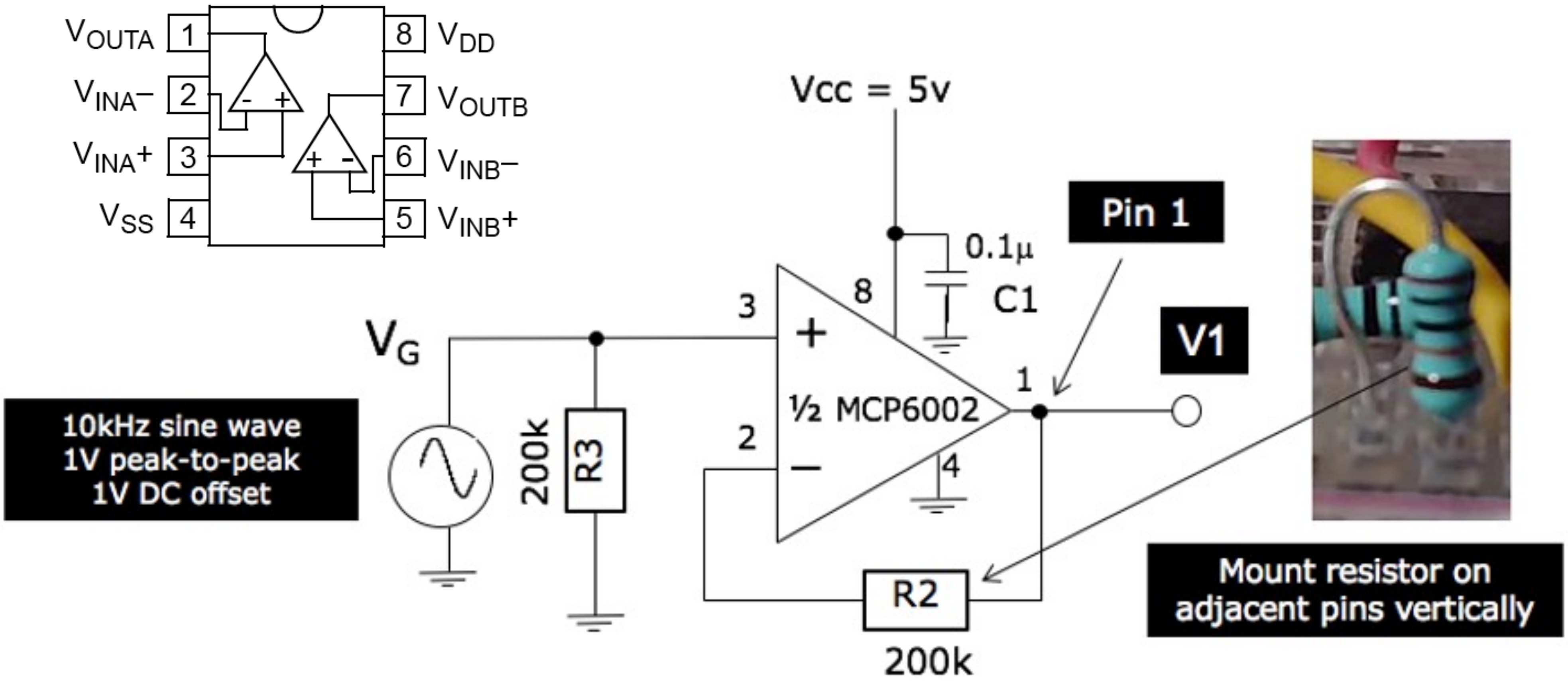




RL	220	470	1k	10k	100k	∞
V_G (mV)						
Rs						

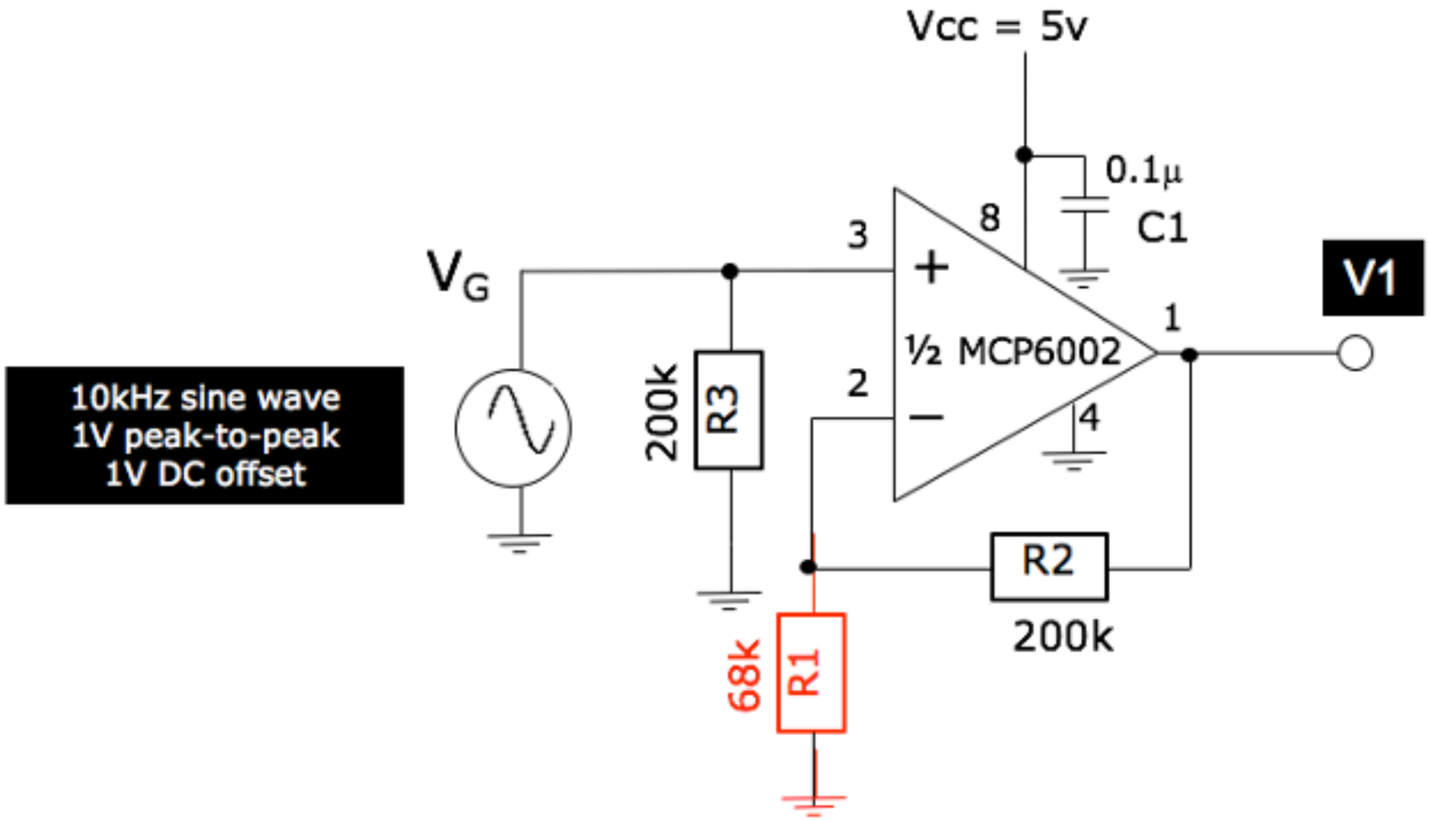
Task 2 – Using a Unity Gain Amplifier (2)

- Add R3 (200k) – makes no difference, but ready for Task 3



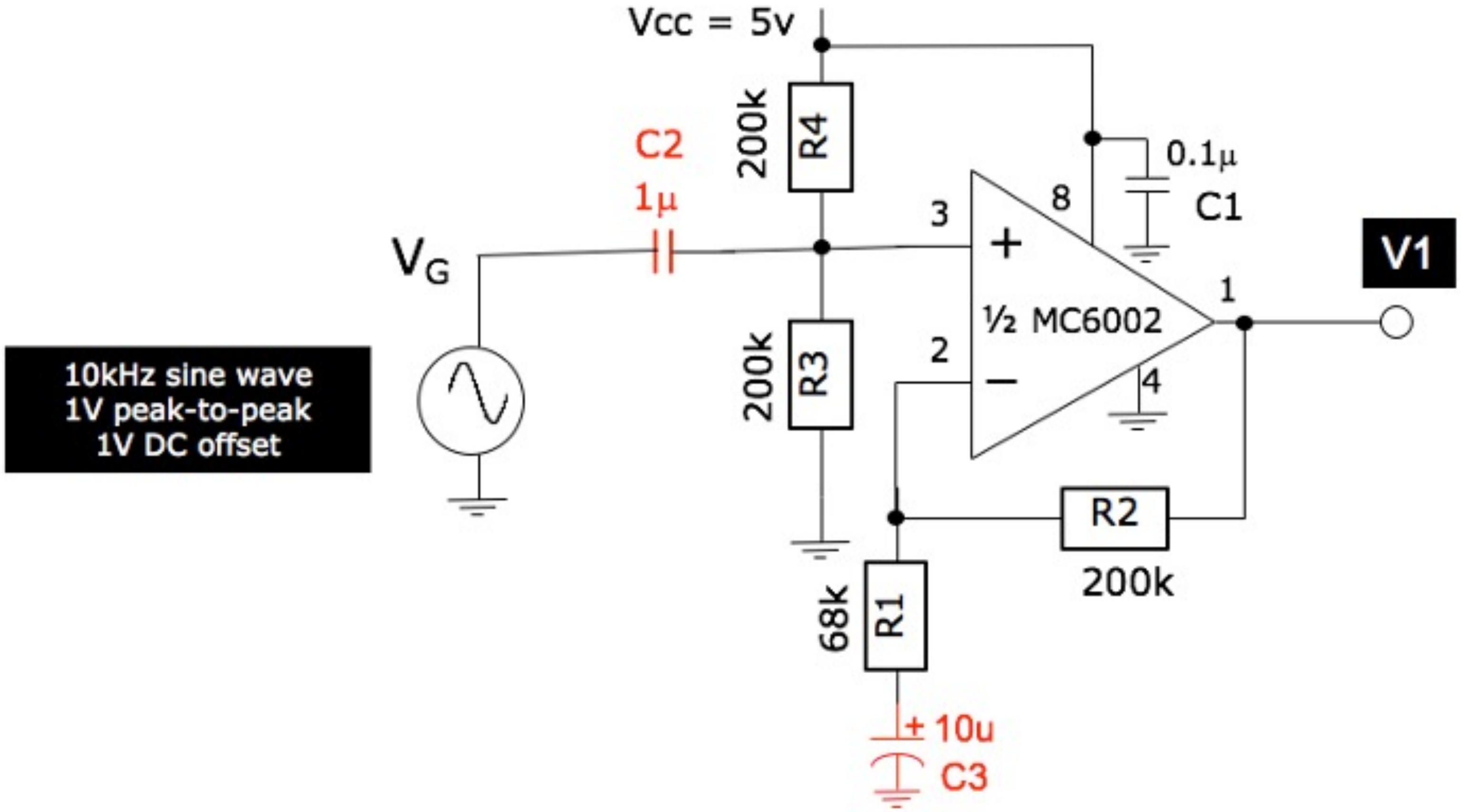
Task 3 – x4 Amplifier Failure (1)

- Add R4. The gain of the amplifier should be x4.
- However, you will see that V_1 shows a sine wave with top of it “clipped”.



Task 3 – x4 Amplifier Success (1)

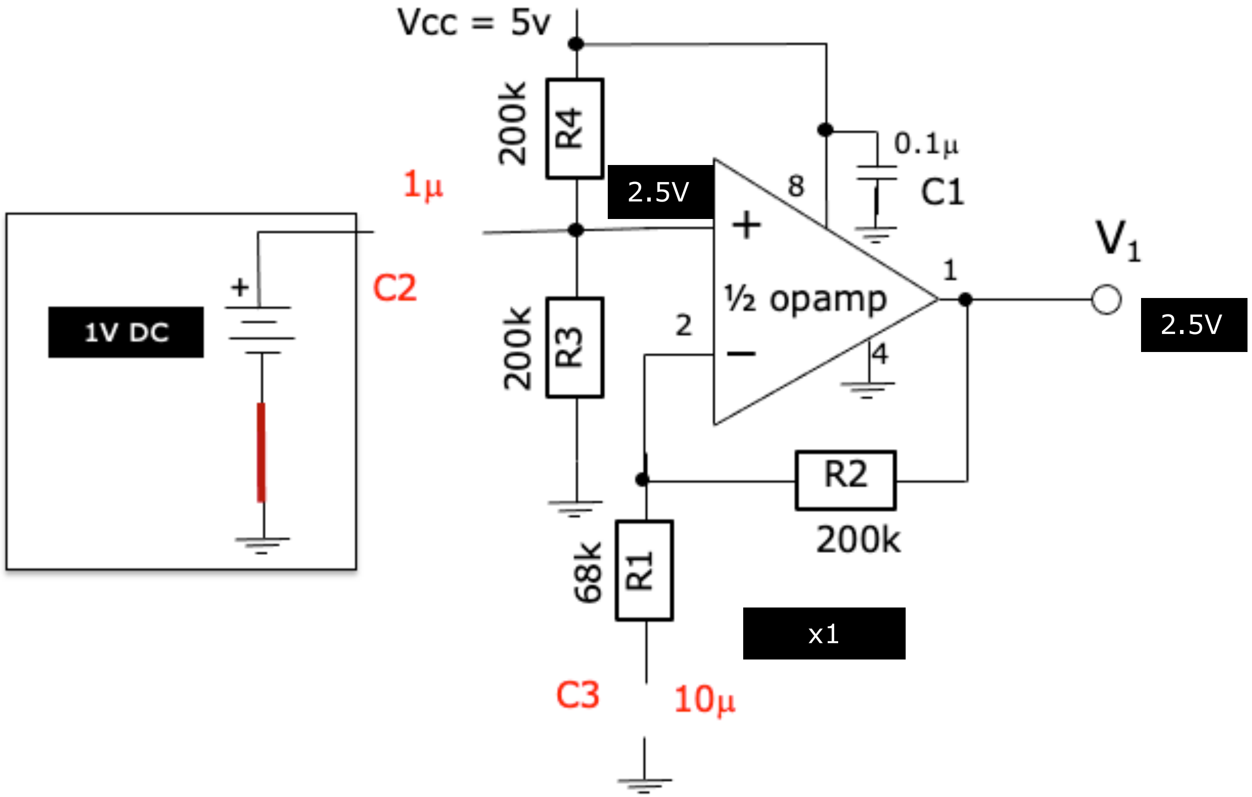
- Add C2 and C3. This will now work. Why?



Task 3 – x4 Amplifier Success (2)

- Consider what happens at DC source (principle of superposition):

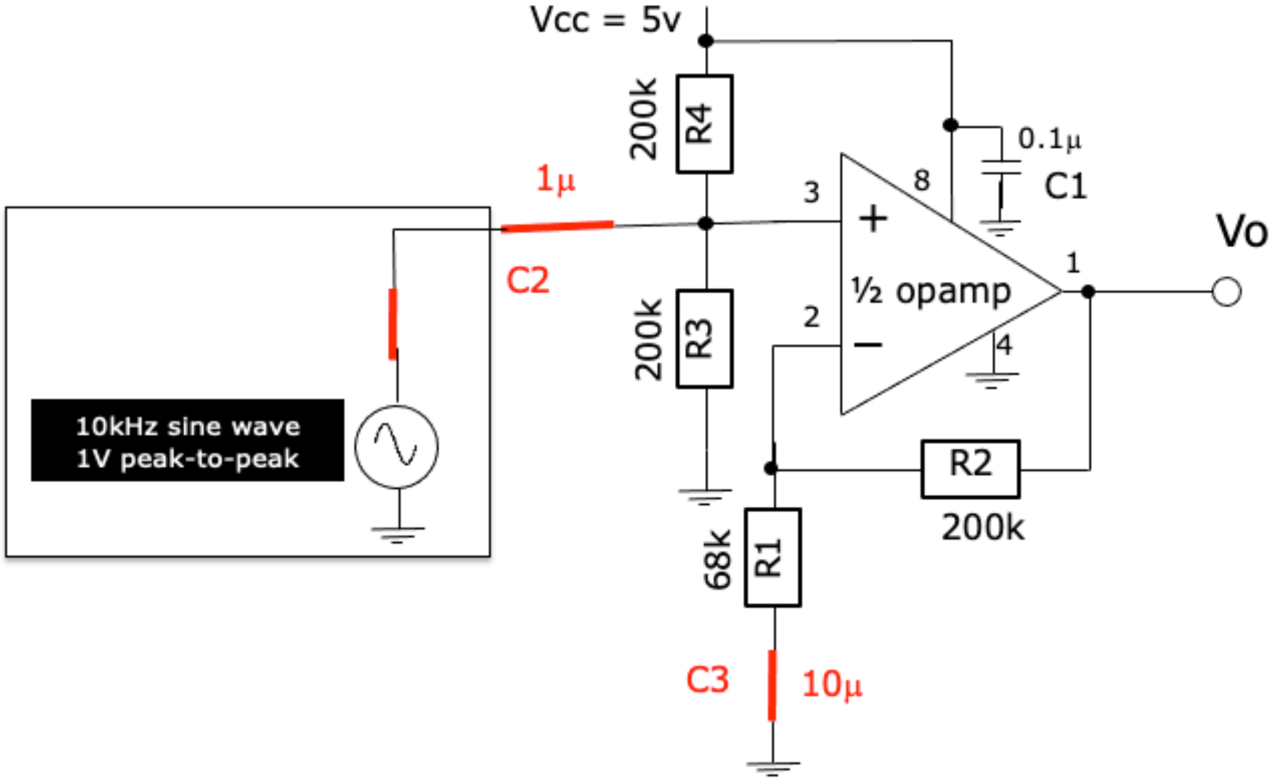
1. C2 is open-circuit, so 2.5V dc is blocked by C2. Instead, V+ is now at 2.5V because of R1 and R2 (voltage divider).
2. C3 is open-circuit. Therefore the op-amp is now a x1 amplifier as in Task 2.



Task 3 – x4 Amplifier Success (3)

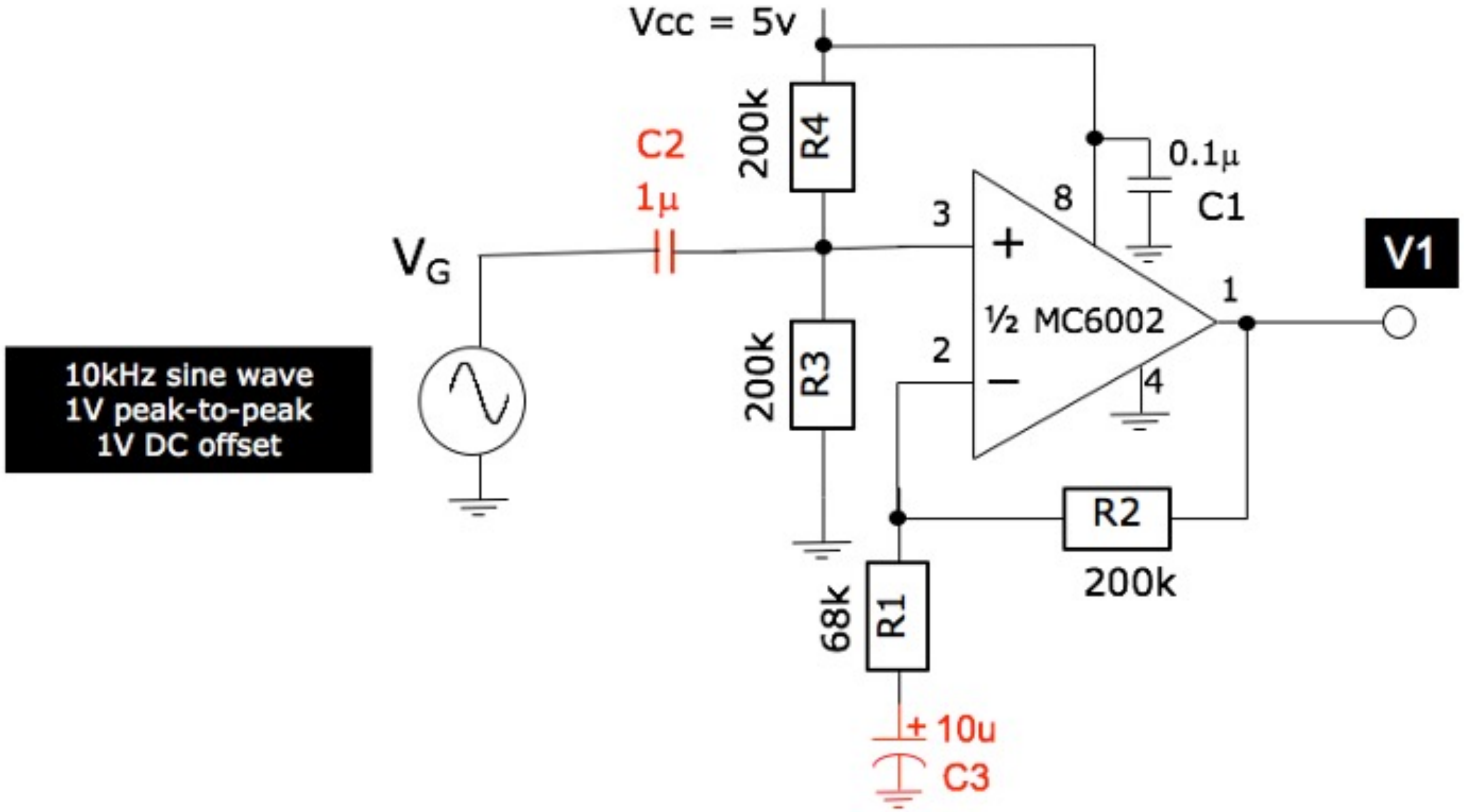
- Consider what happens at high frequency (e.g. 10kHz sine wave):

1. C2 is short-circuit, so V_G goes directly to V+.
2. C3 is short-circuit. Therefore the op-amp is now a x4 amplifier



Task 4 – Better bias circuit (1)

- Bias voltage at pin 3 is poor because ……

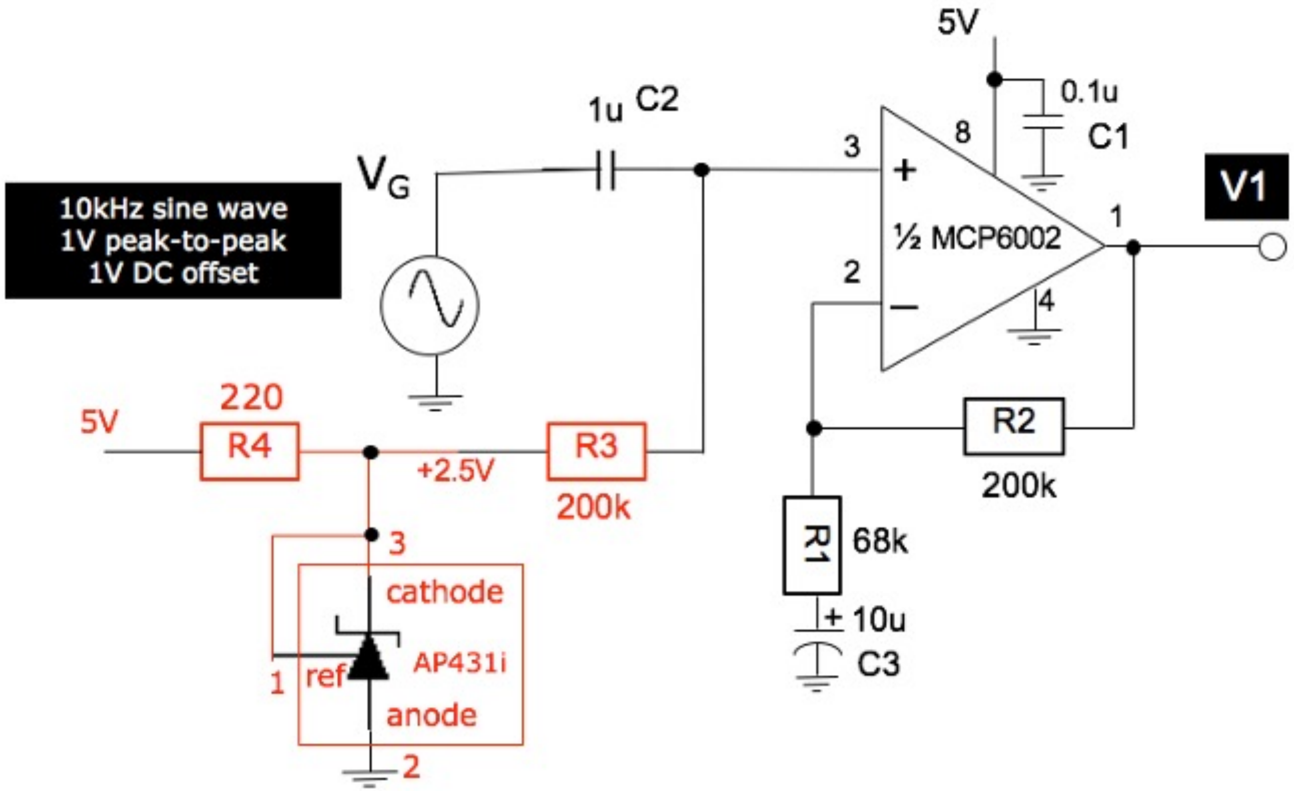


Task 4 – Better bias circuit (2)

- Replace resistor divider bias circuit with proper voltage reference

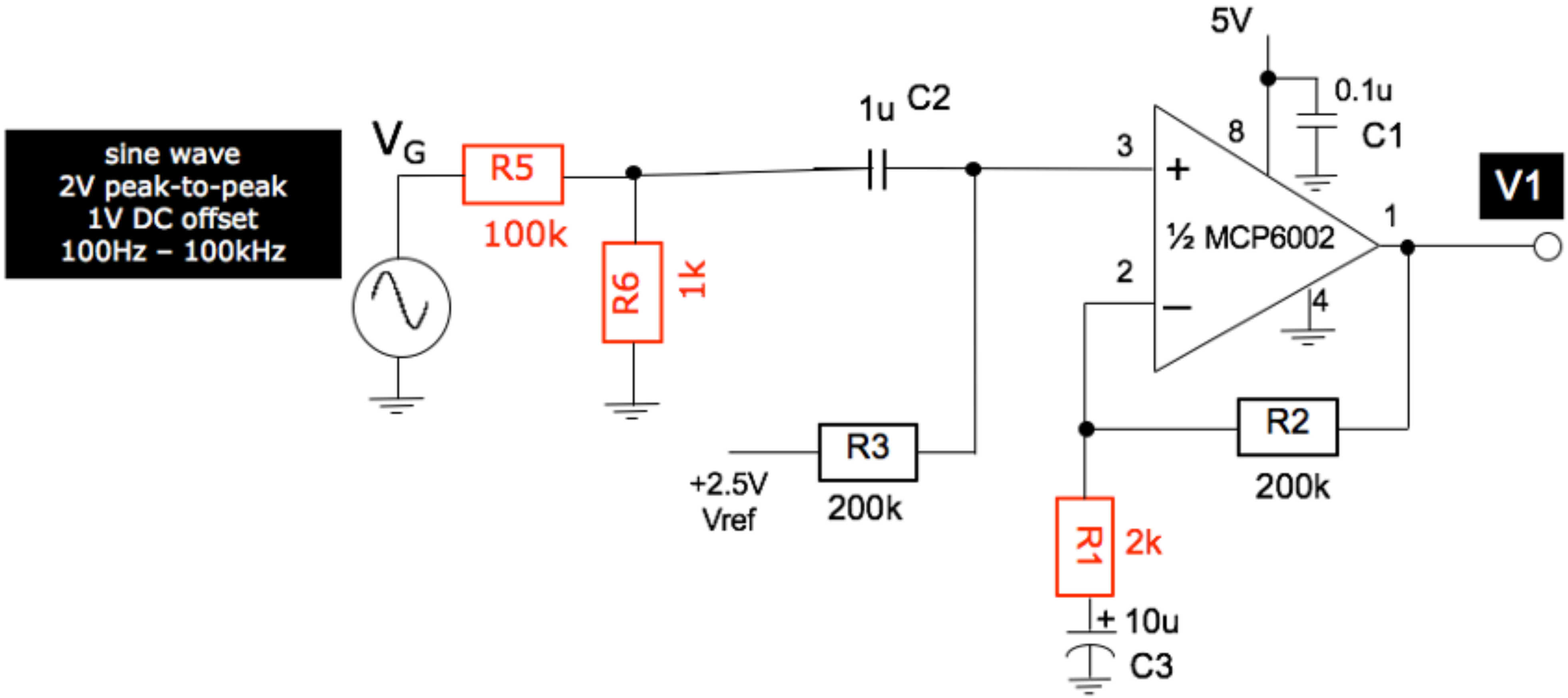
  Why is R3 necessary?

  What is the loading seen by the PicoScope signal generator?

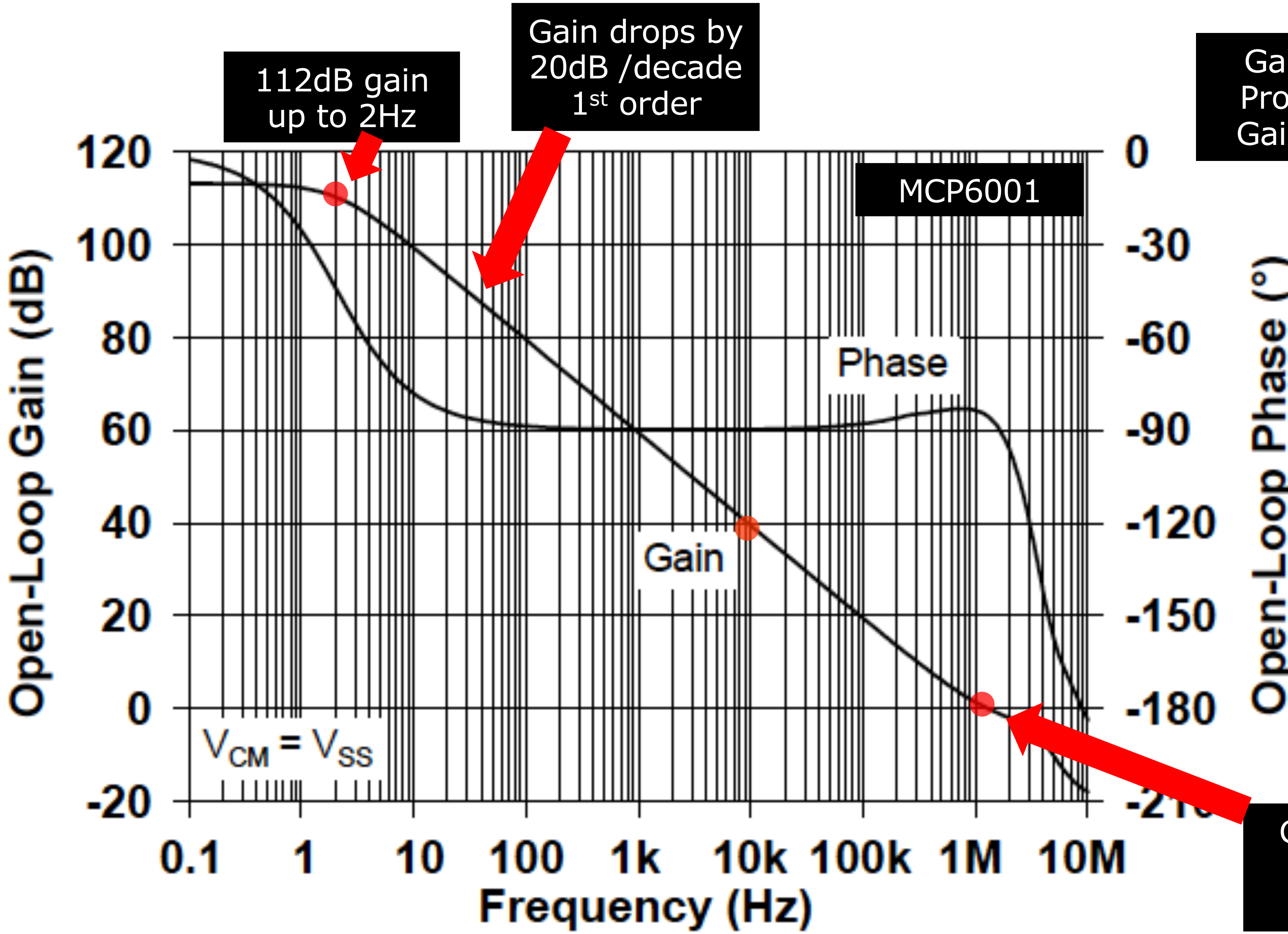


Task 5 – Large Gain amplifier failure

- Replace R1 with 2k ohm resistor. Gain = 1 + R2/R1 = 101



Task 5 – Gain-Bandwidth Product limit

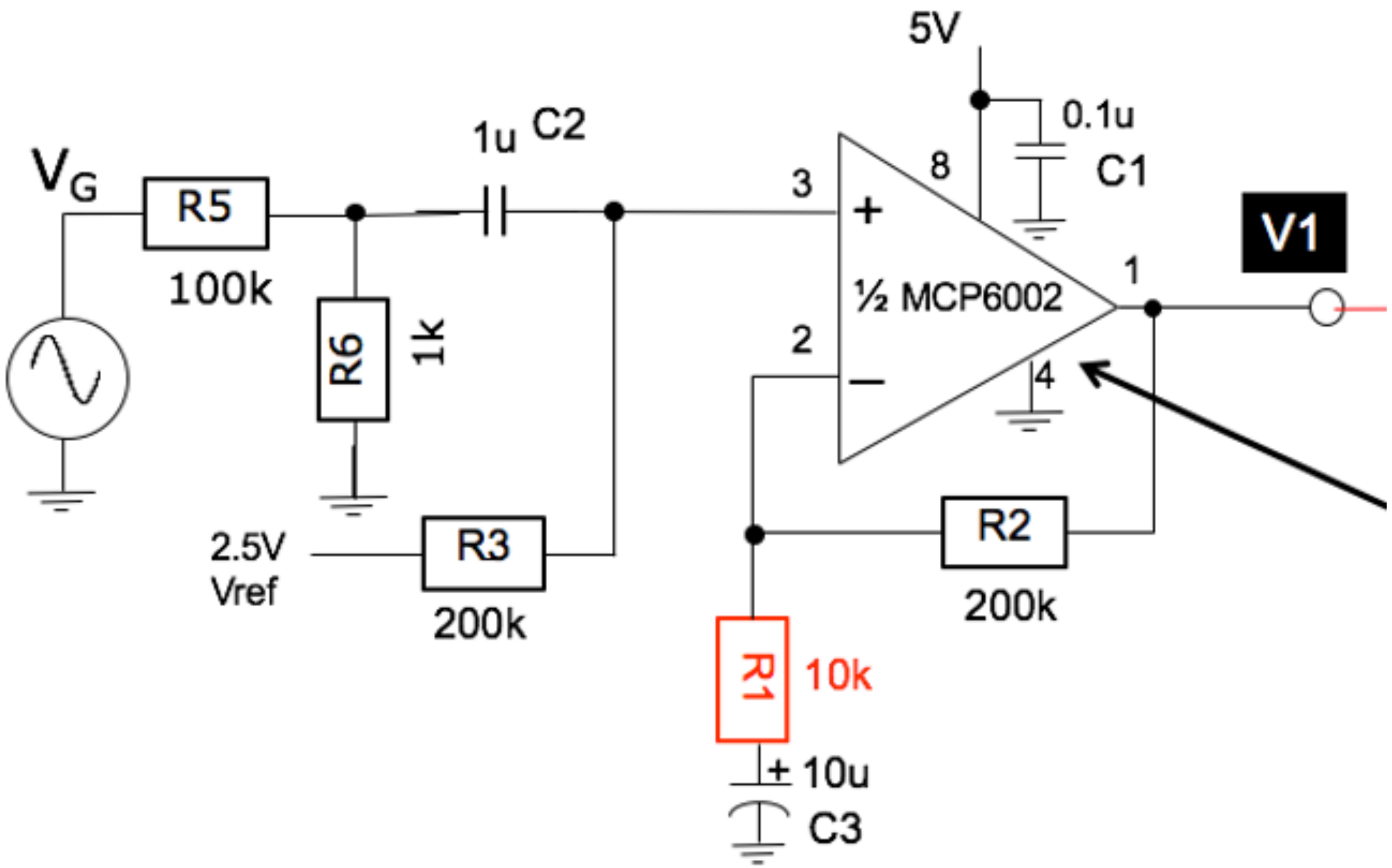


Gain-Bandwidth Product (GBP) = Gain x frequency

GBP for MCP6001 is 1MHz

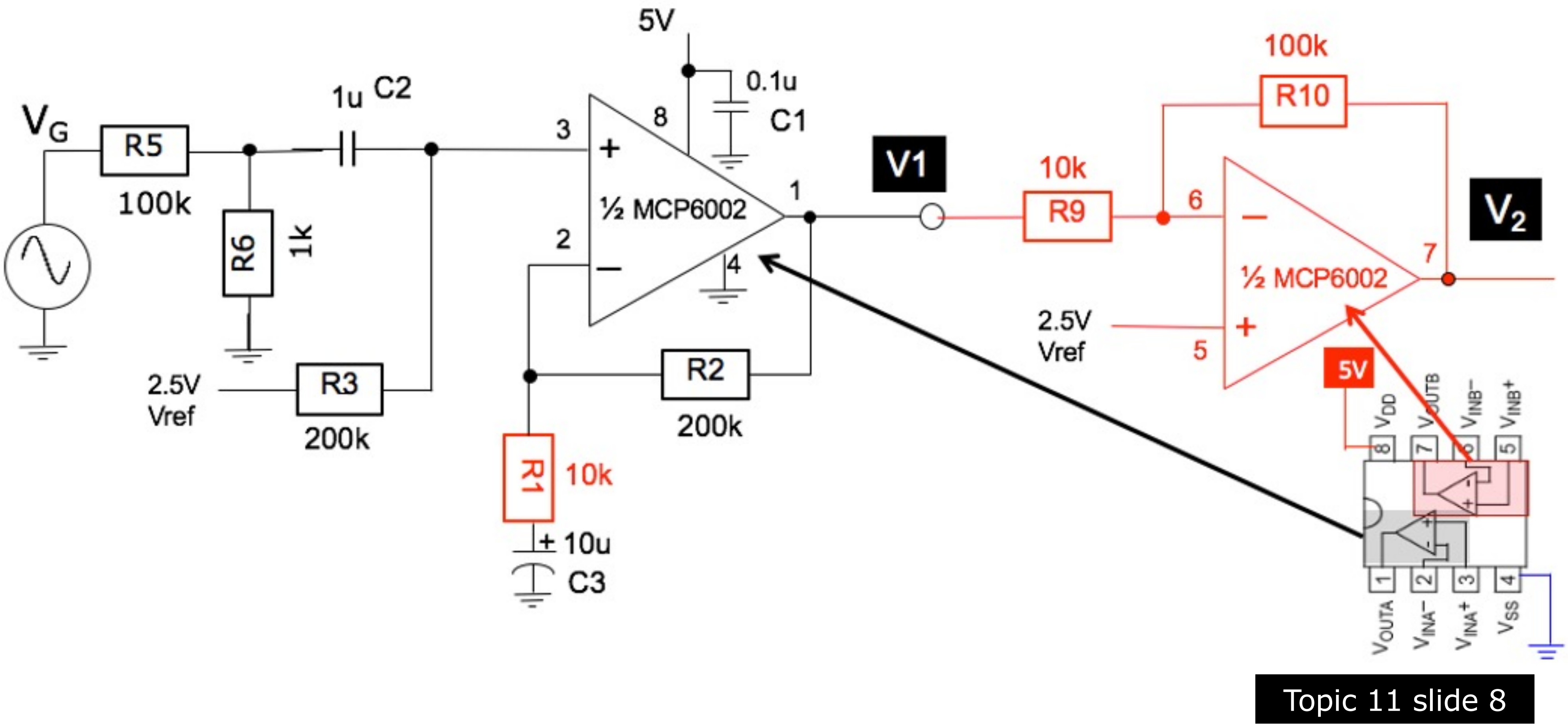
Task 6 – High gain amplifier in 2 stages (1)

- Stage 1: non-inverting amplifier with GAIN = 21
- Replace R1 with a 10k ohm resistor. Now gain is x21



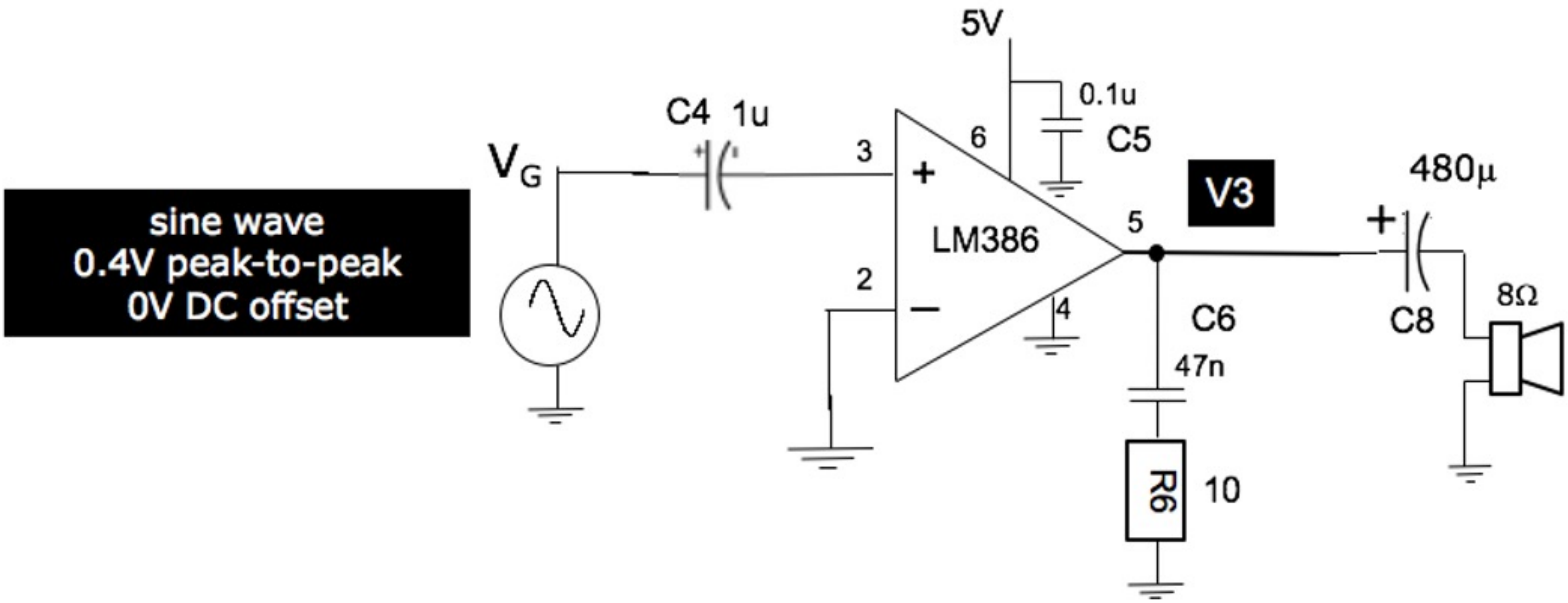
Task 6 – x210 amplifier in 2 stages (2)

- Stage 2: inverting amplifier with GAIN = -10 (circuit in RED)
- Now check Vo1 and Vo2



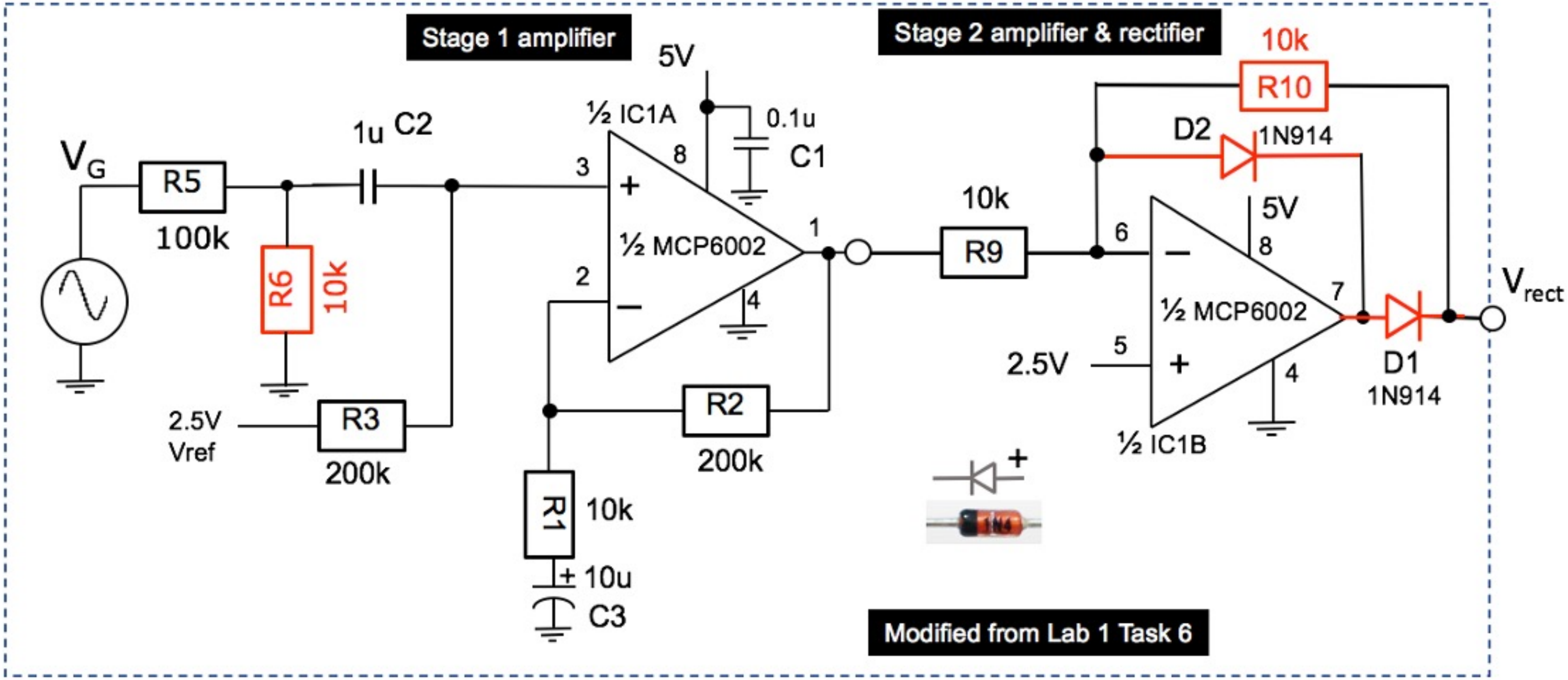
Task 7 – Audio Amplifier for 8 ohm speaker

- Op-amp only can only deliver at most 20mA current at its output
- Need special amplifier to drive 8 ohm speaker
- Use special amplifier for this purpose



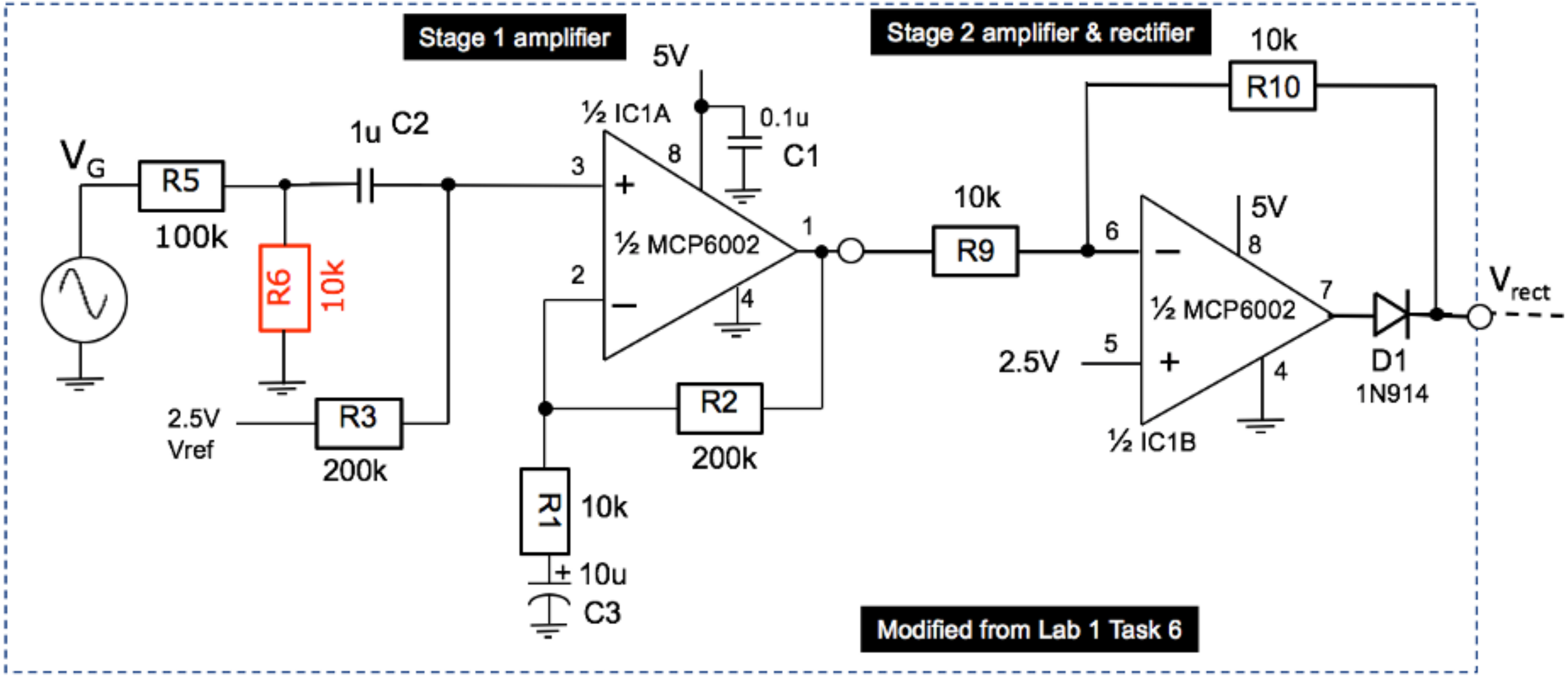
Lab 2 Task 1 – Half-wave Rectifier

- Good half-wave rectifier



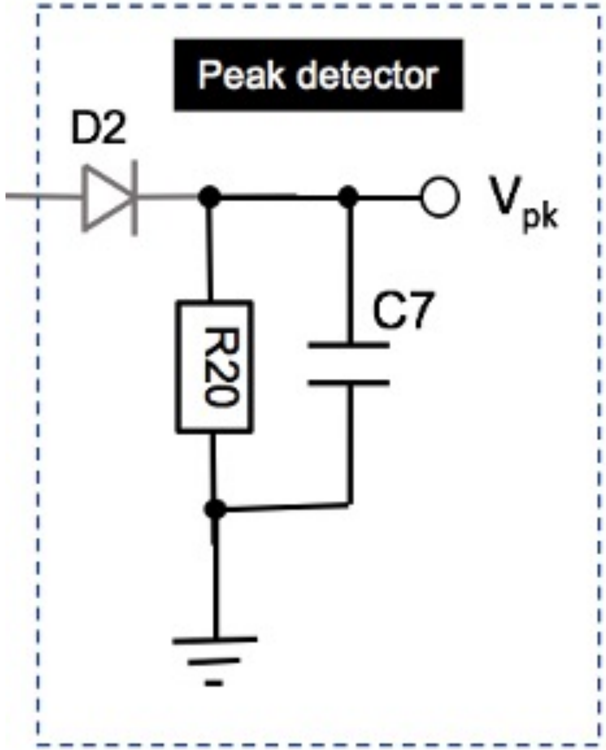
Lab 2 Task 1 – Full-wave rectifier

- Poor full-wave rectifier



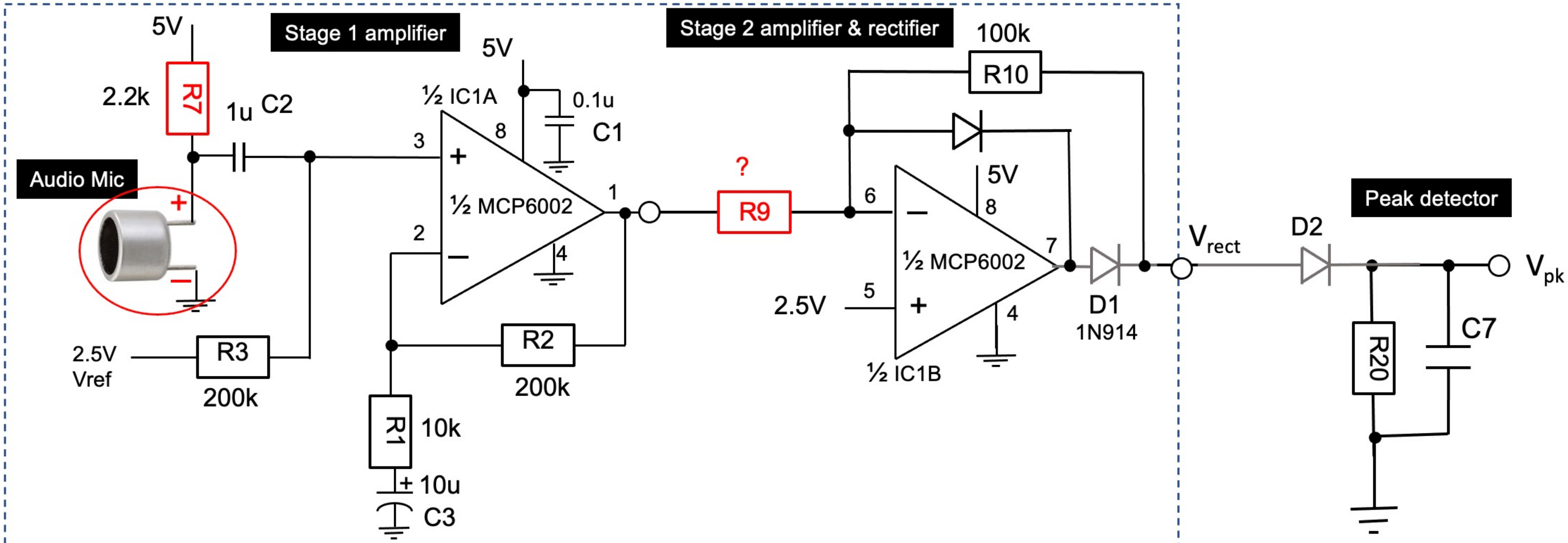
Lab 2 Task 1 – Peak detection

- Peak detecting

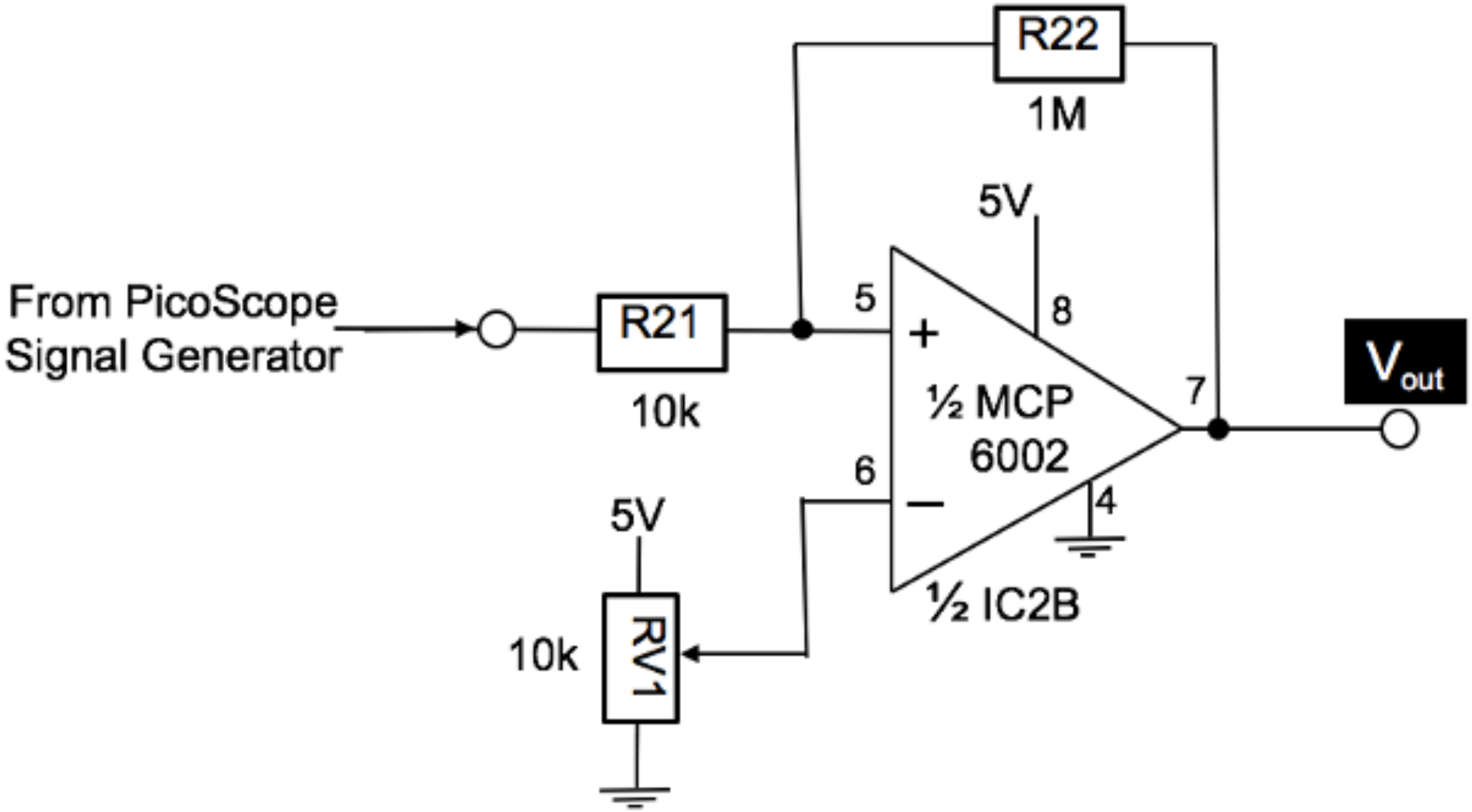


Lab 2 Task 1 – Sound level detection

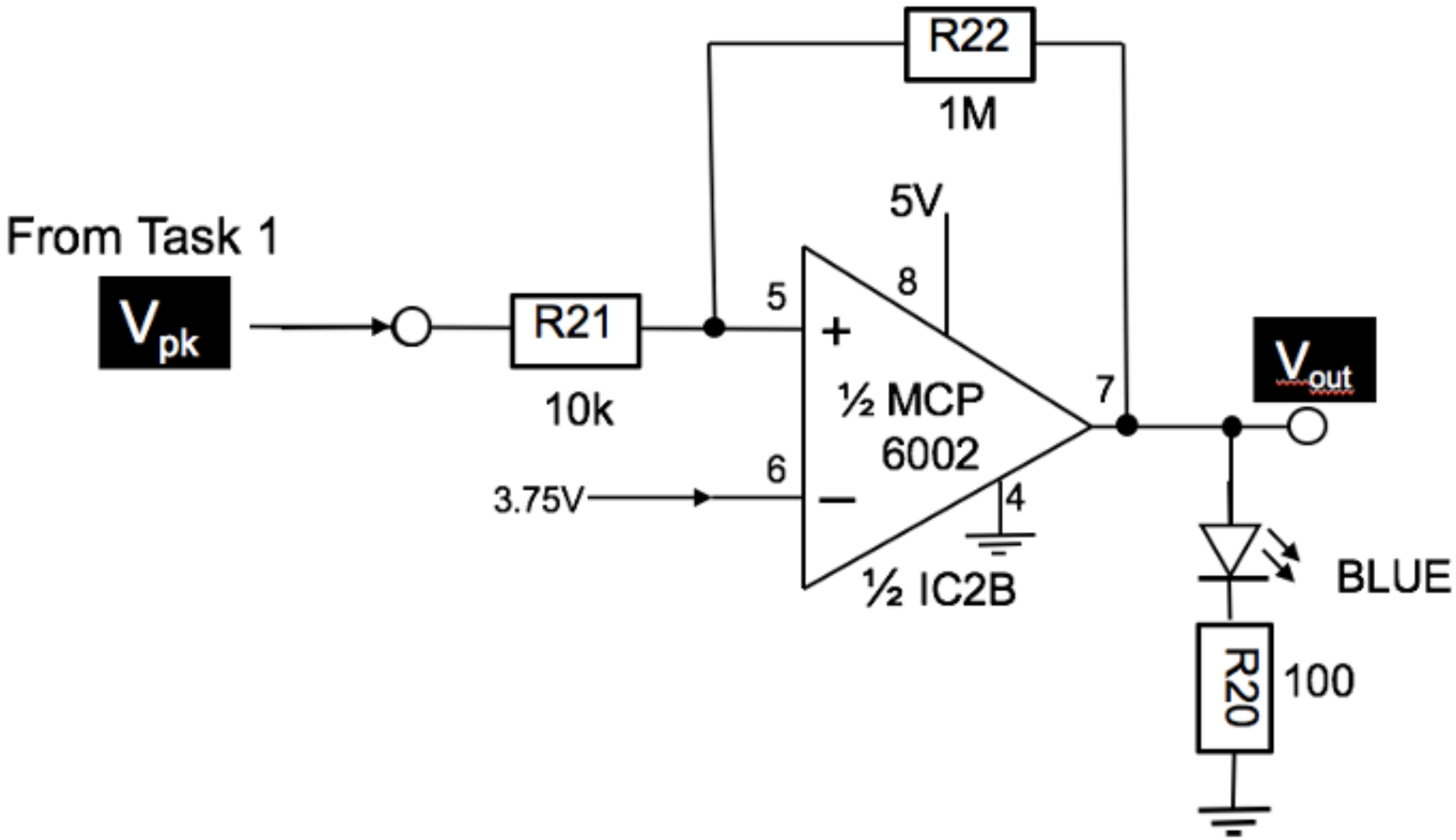
- R9 – estimate or measure, not easy to calculate



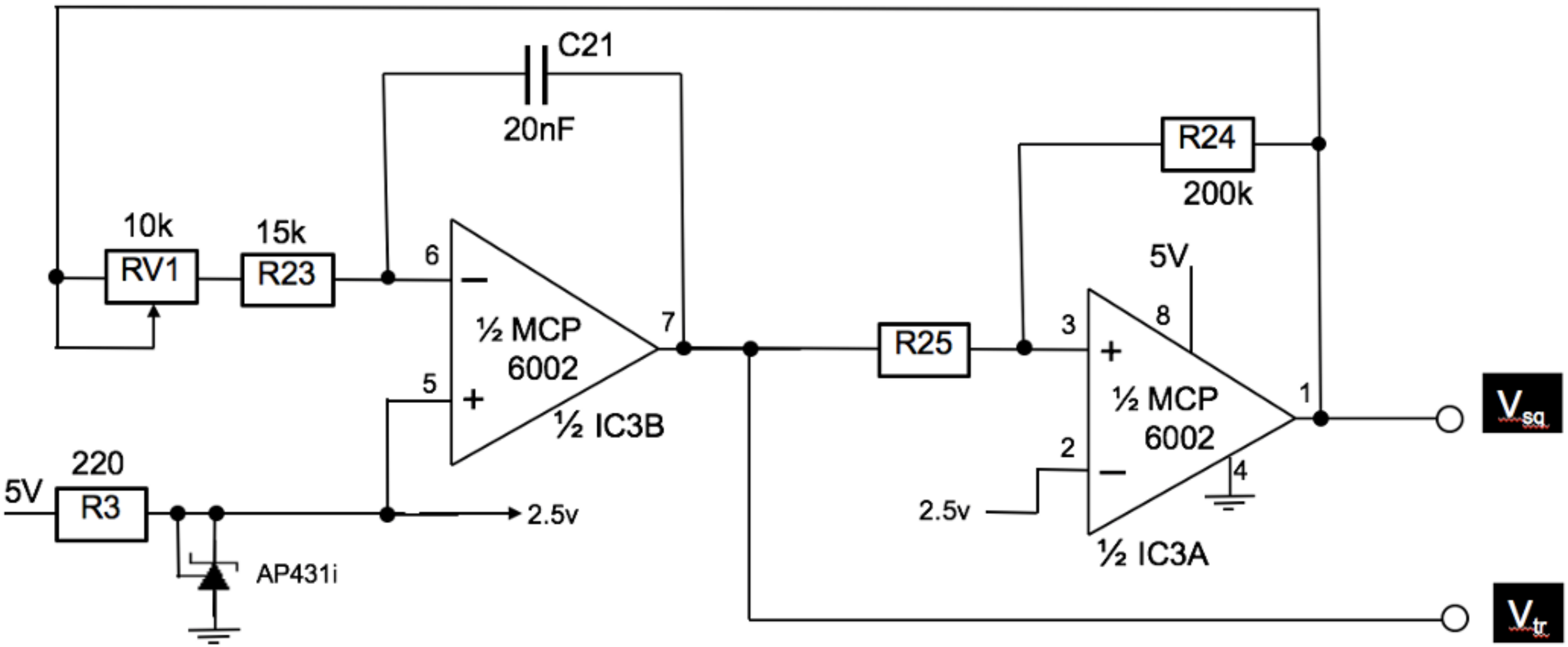
Lab 2 Task 2 – Comparator with hysteresis



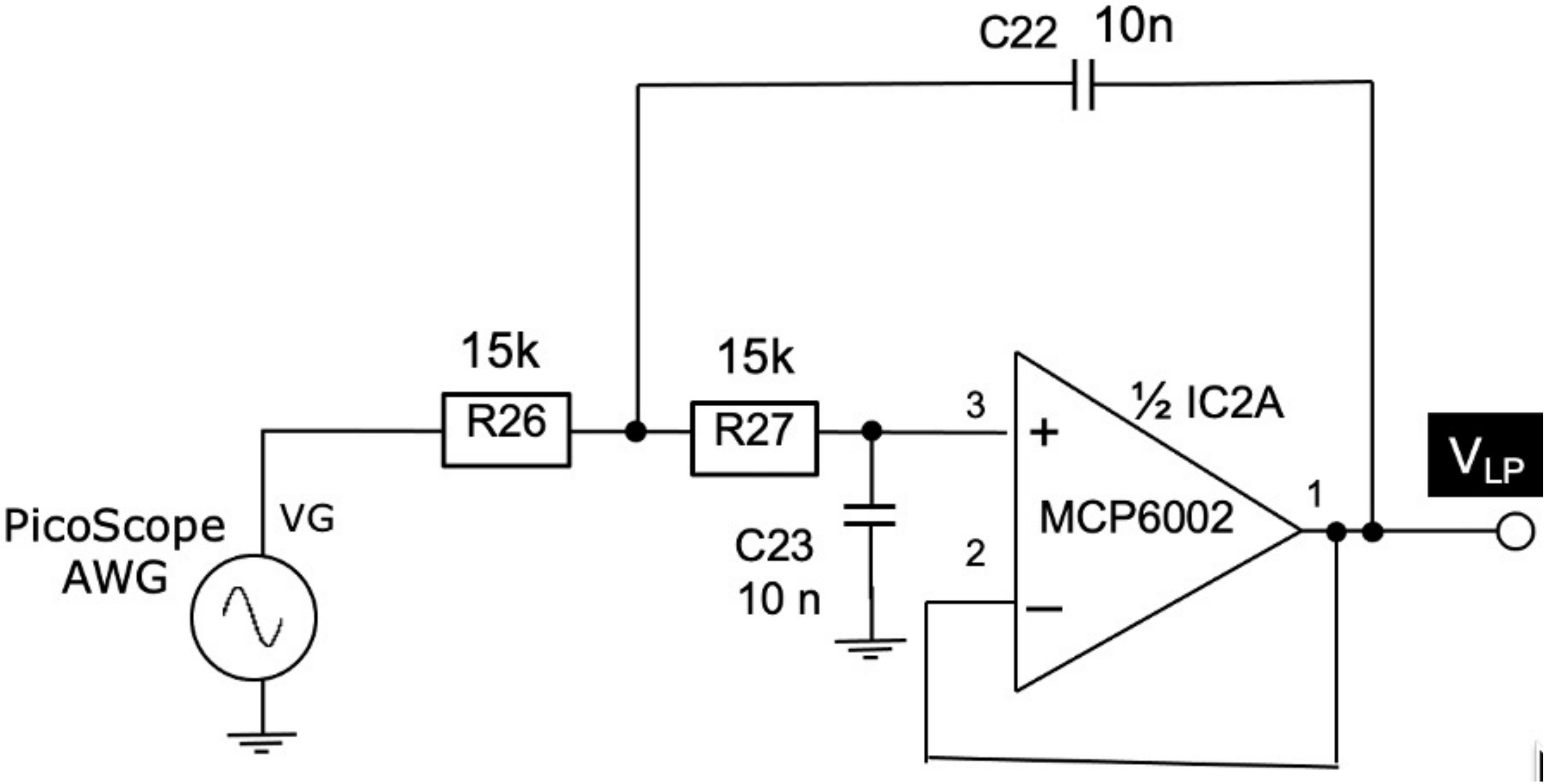
Lab 2 Task 2 – Comparator to detect sound



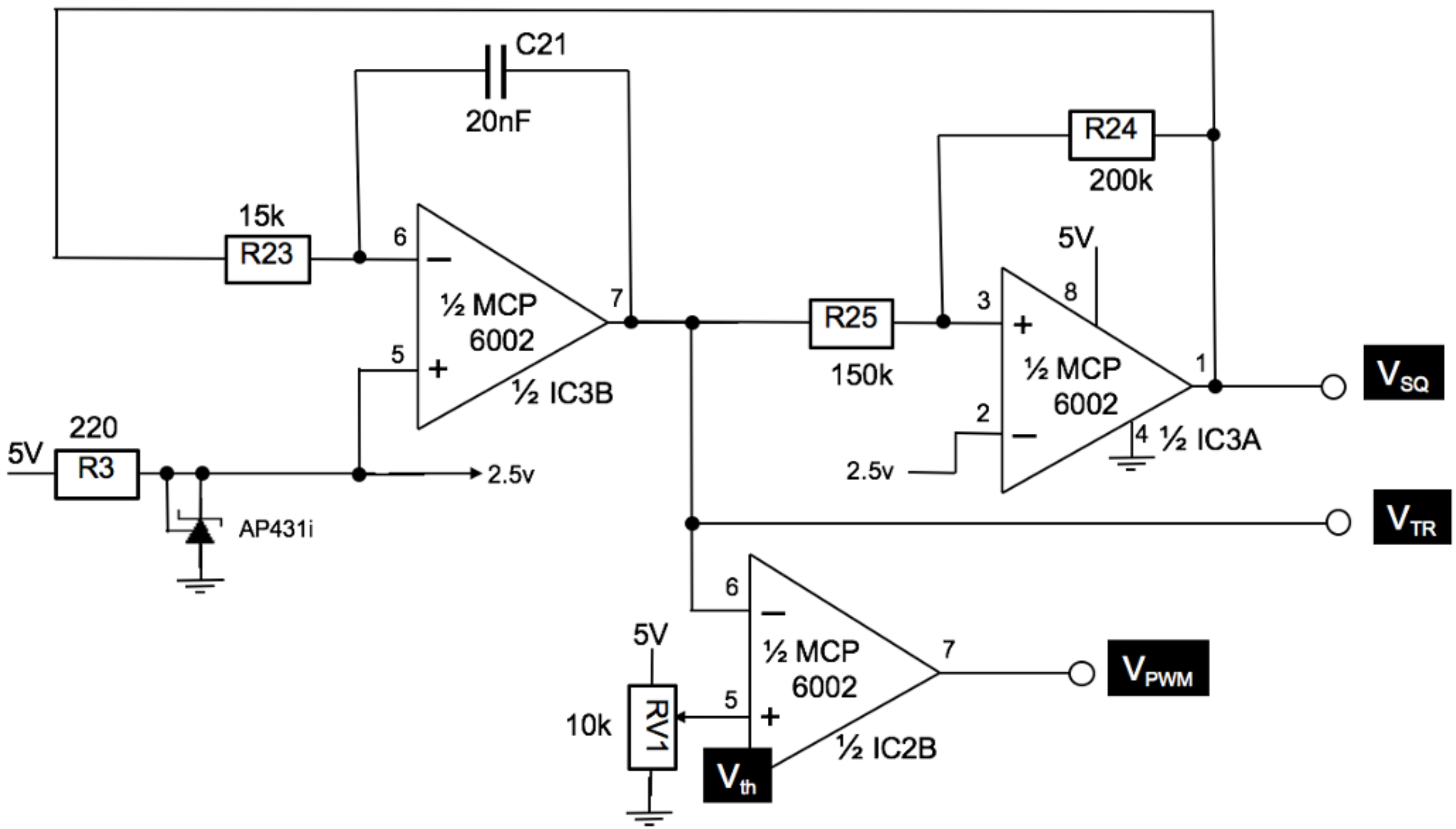
Lab 2 Task 3 – Function Generator



Lab 2 Task 4 – Lowpass filter



Lab 2 Task 5 – Pulse-width modulator



Lab 2 Task 5 – Pulse-width modulator