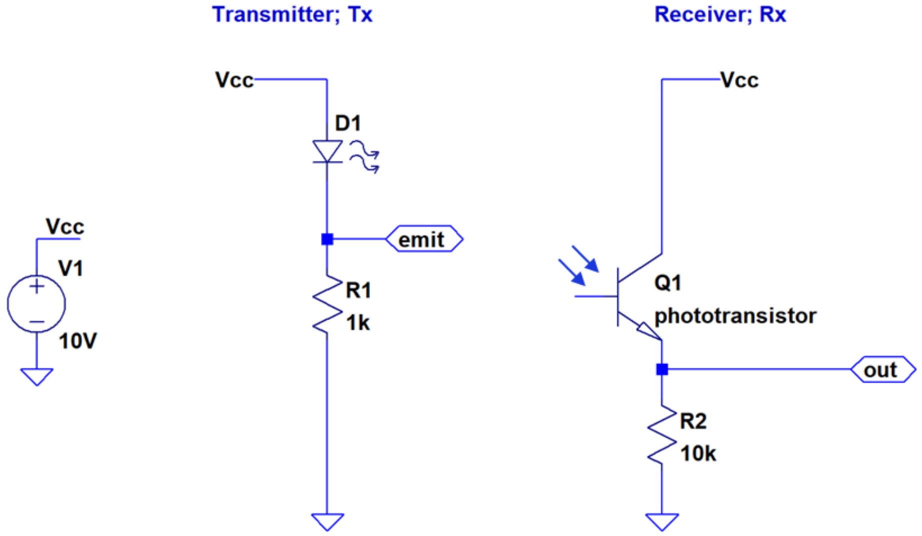
REPORT

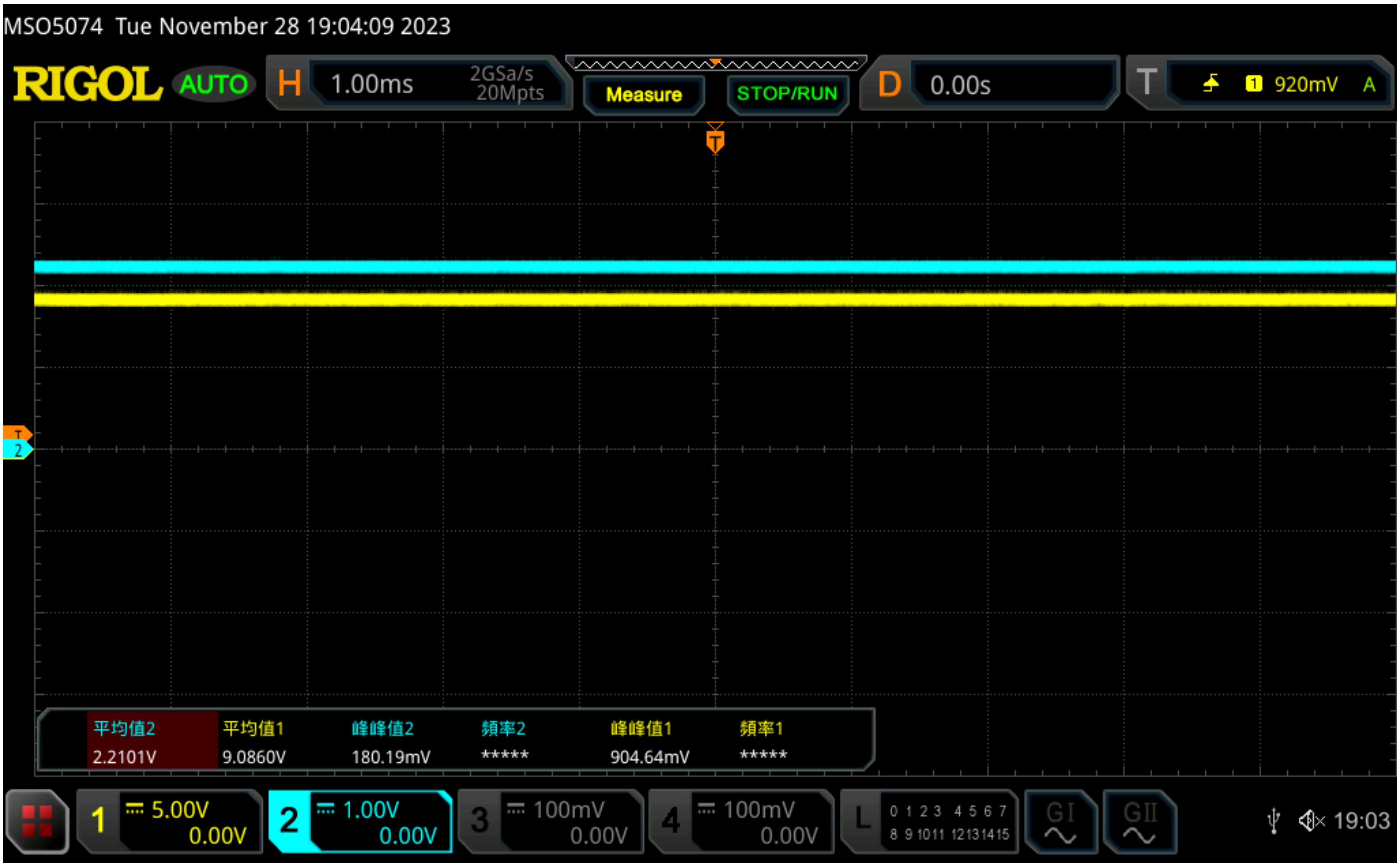
Experiment 1: Optical Transmission and Operation Point



1.

$V_{emit,DC}$ (V)	**8.84**
$V_{out,\ DC}$ (V)	**1.04**

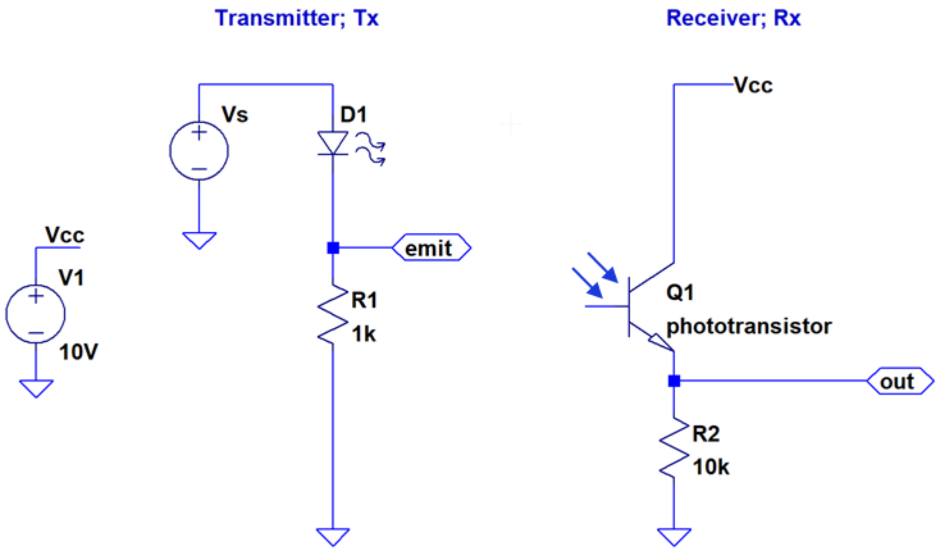
V_{emit} and V_{out} waveform **(DC coupling)**



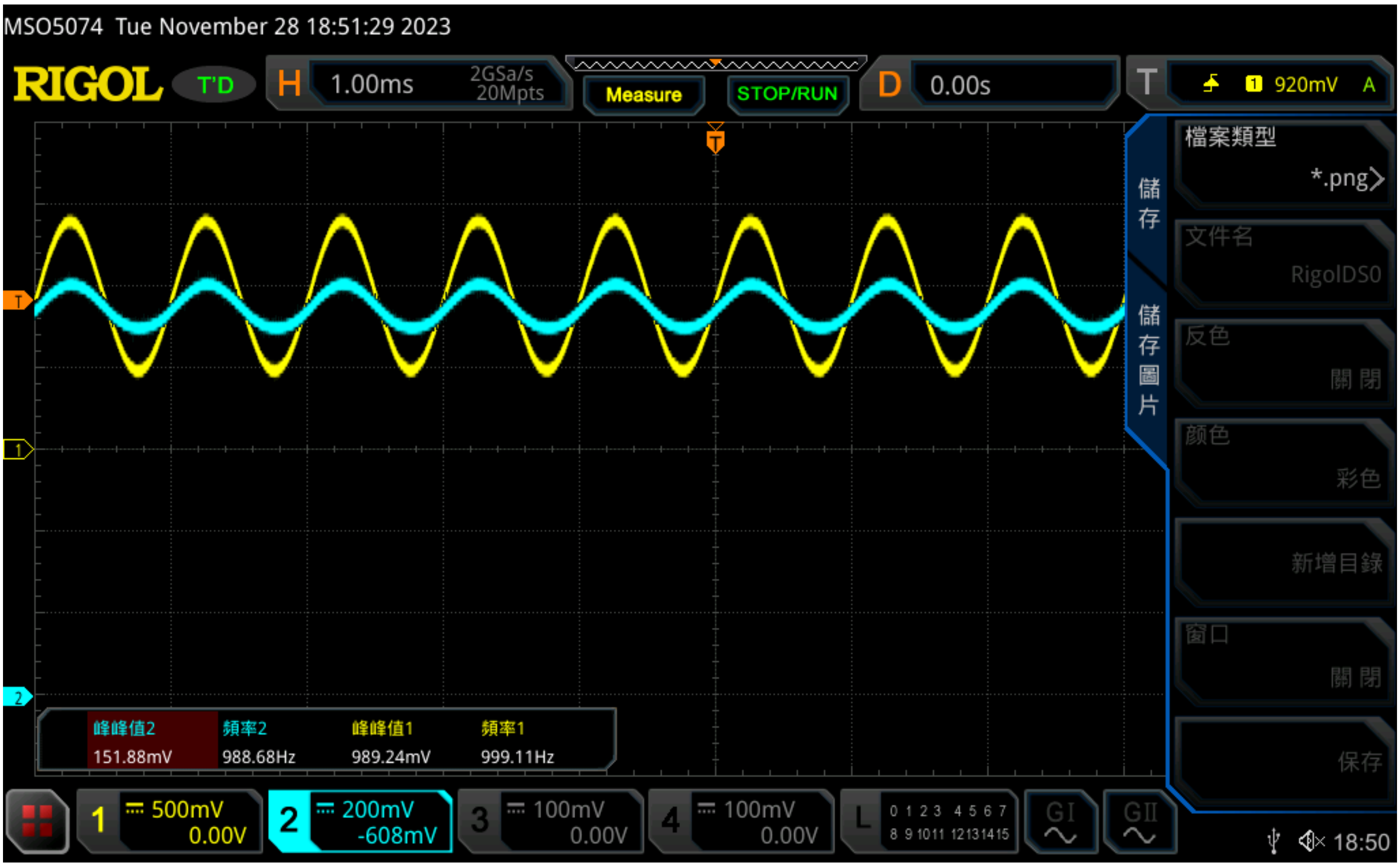
IR Transmitter and Receiver

2,

2Vs:
Sine,
f = 1 KHz,
V_{pp} = 1 Vpp,
V_{offset} = 2 V_{DC}

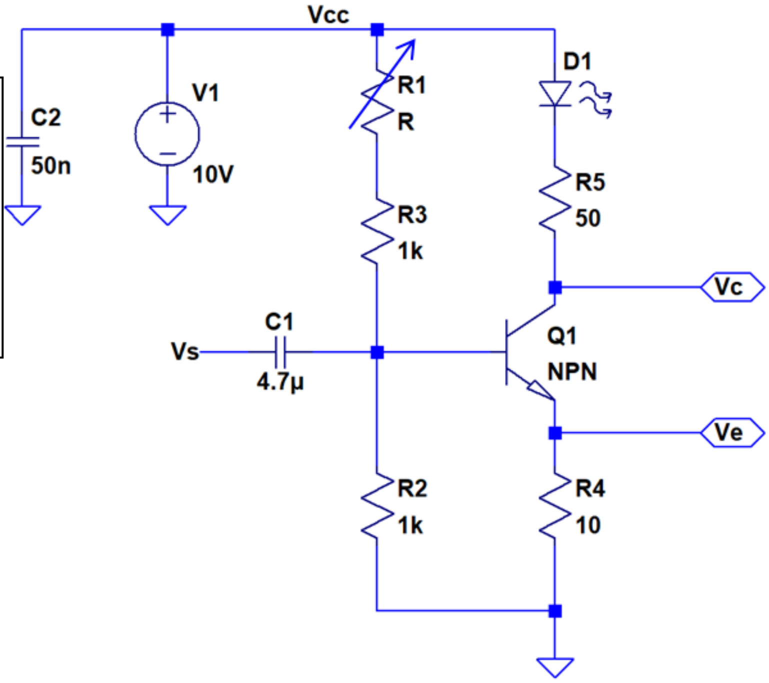


waveform in node “emit” and “out.”



Experiment 2: Gain Stage - BJT Common Emitter Configuration

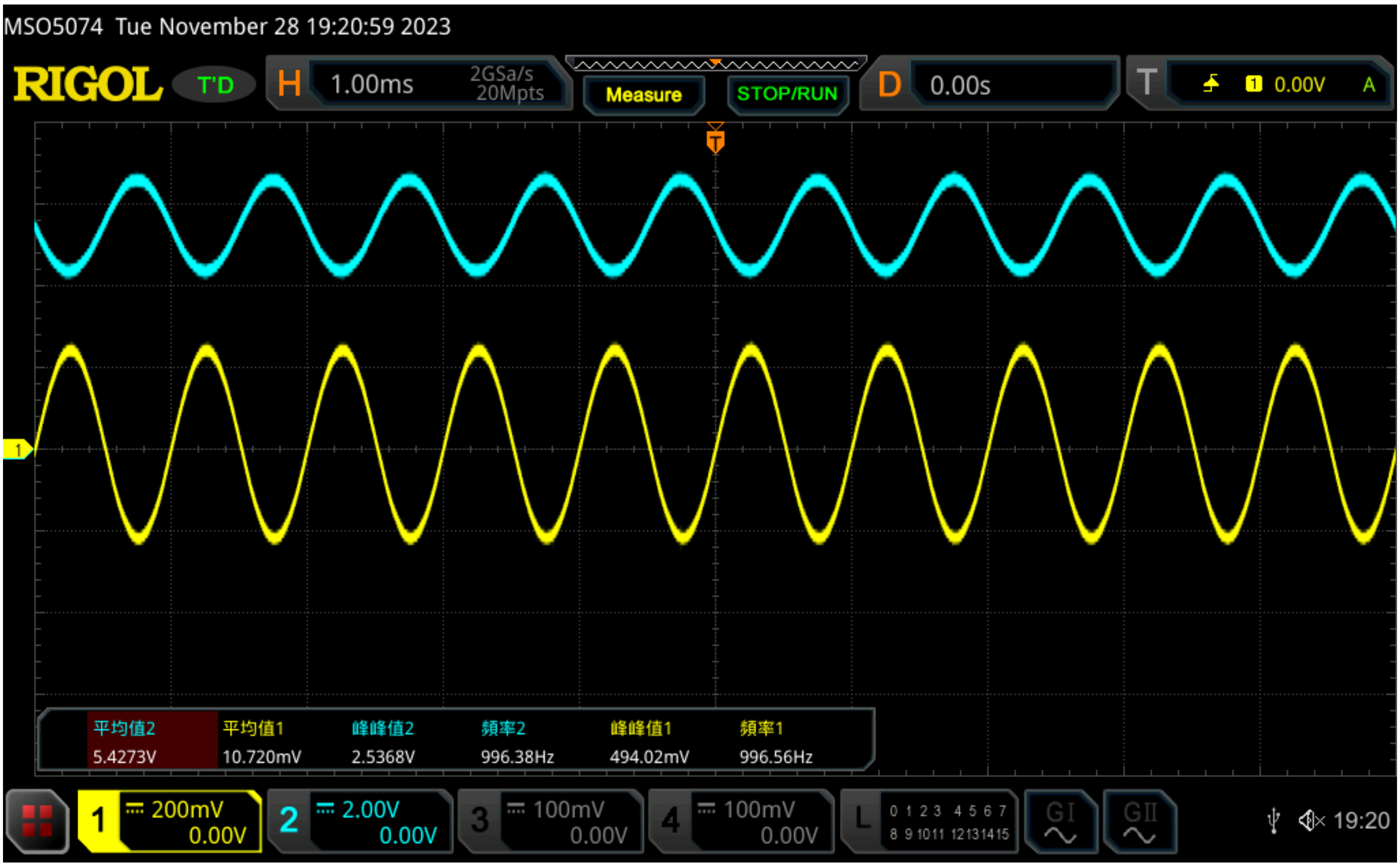
Vs:
Sine,
f = 1 KHz,
V_{pp} = 500 mVpp,
V_{offset} = 0 V_{DC}



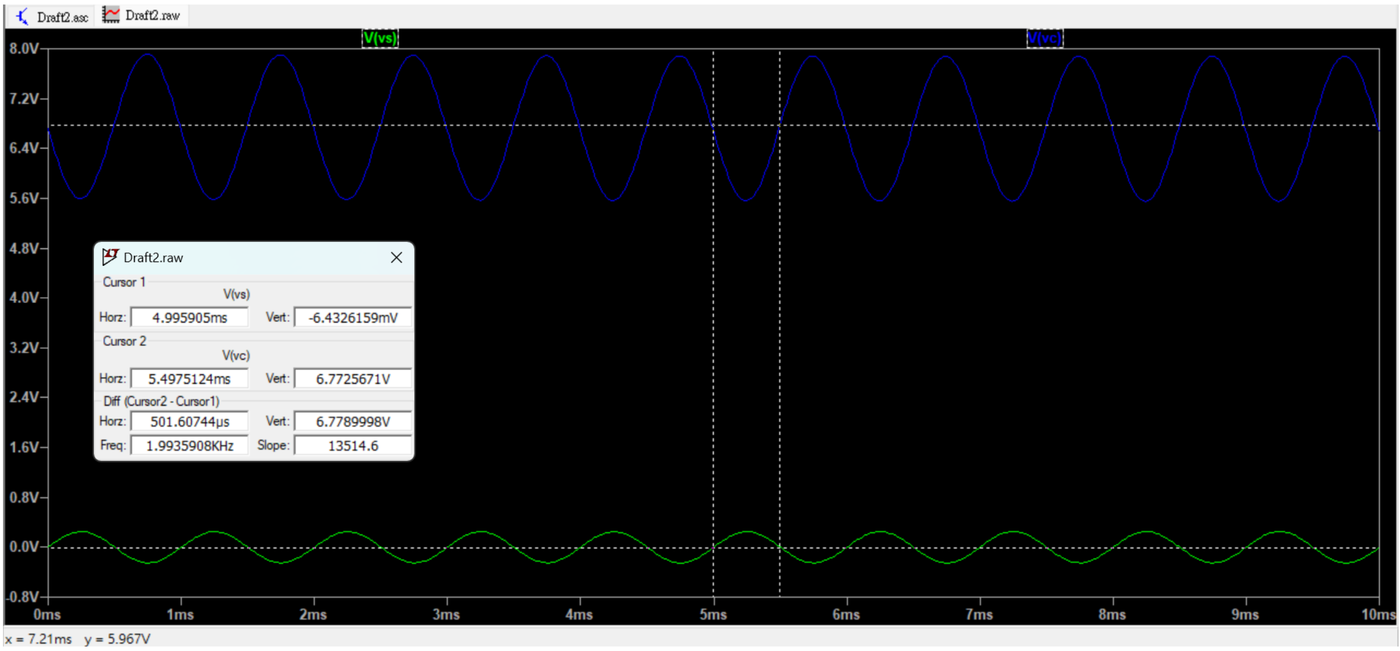
V_B (V)	V_C (V)	V_E (V)	Vs,pp(V)	Vc,pp(V)	Ve,pp(V)
1.22	**5.30**	**0.54**	**502.54m**	**2.5368**	**555.56m**

IR Transmitter and Receiver

Vs and Vc waveform

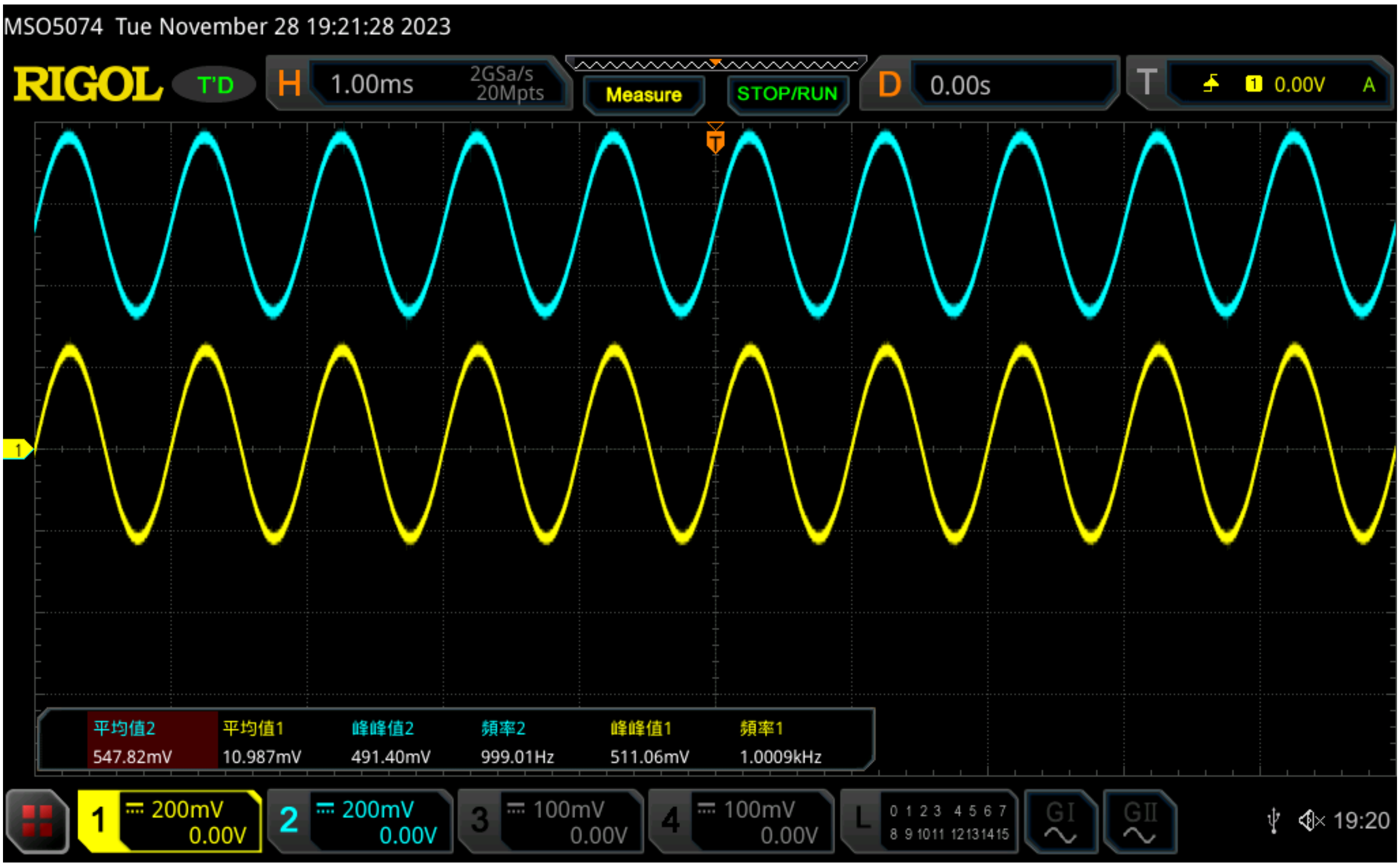


Vs and Vc SPICE simulation

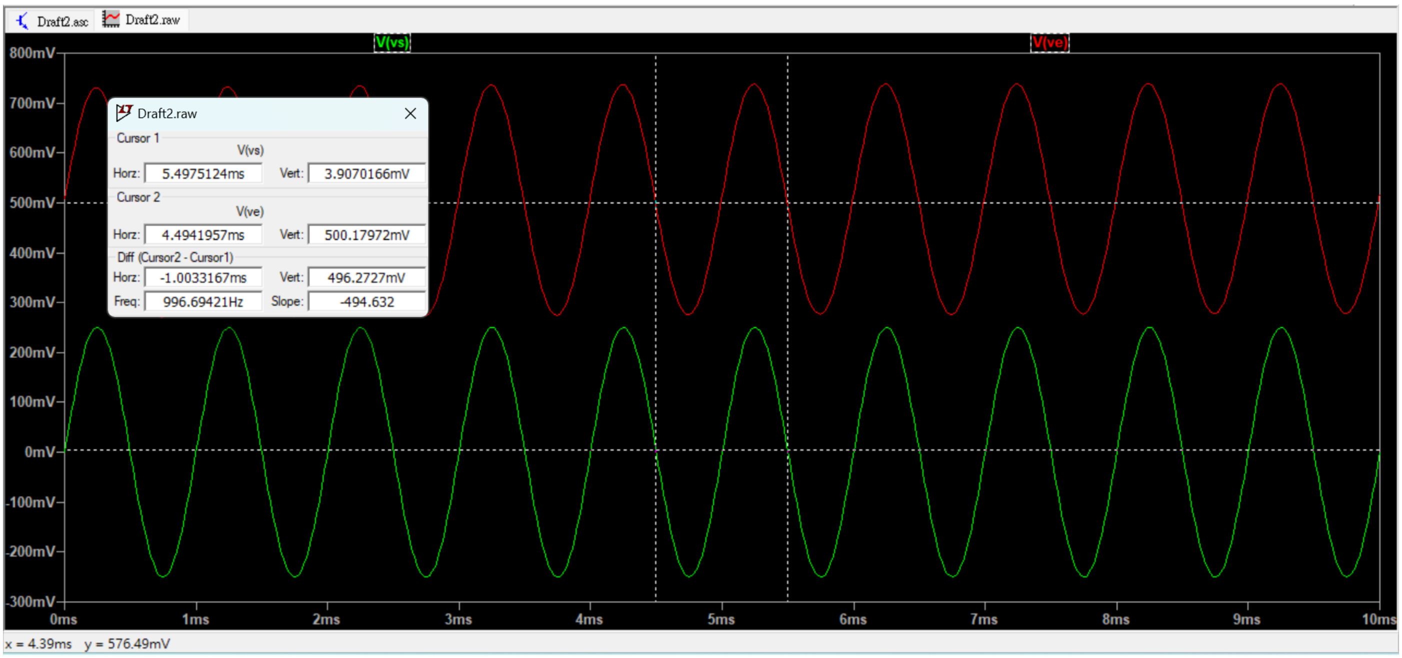


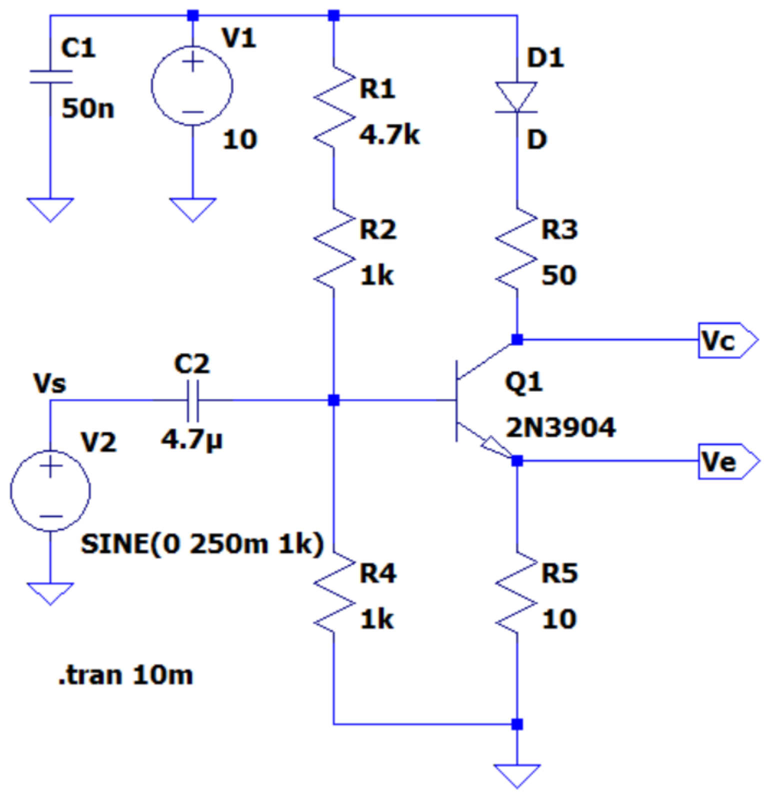
IR Transmitter and Receiver

Vs and Ve waveform



Vs and Ve SPICE simulation





Common Emitter Configuration:

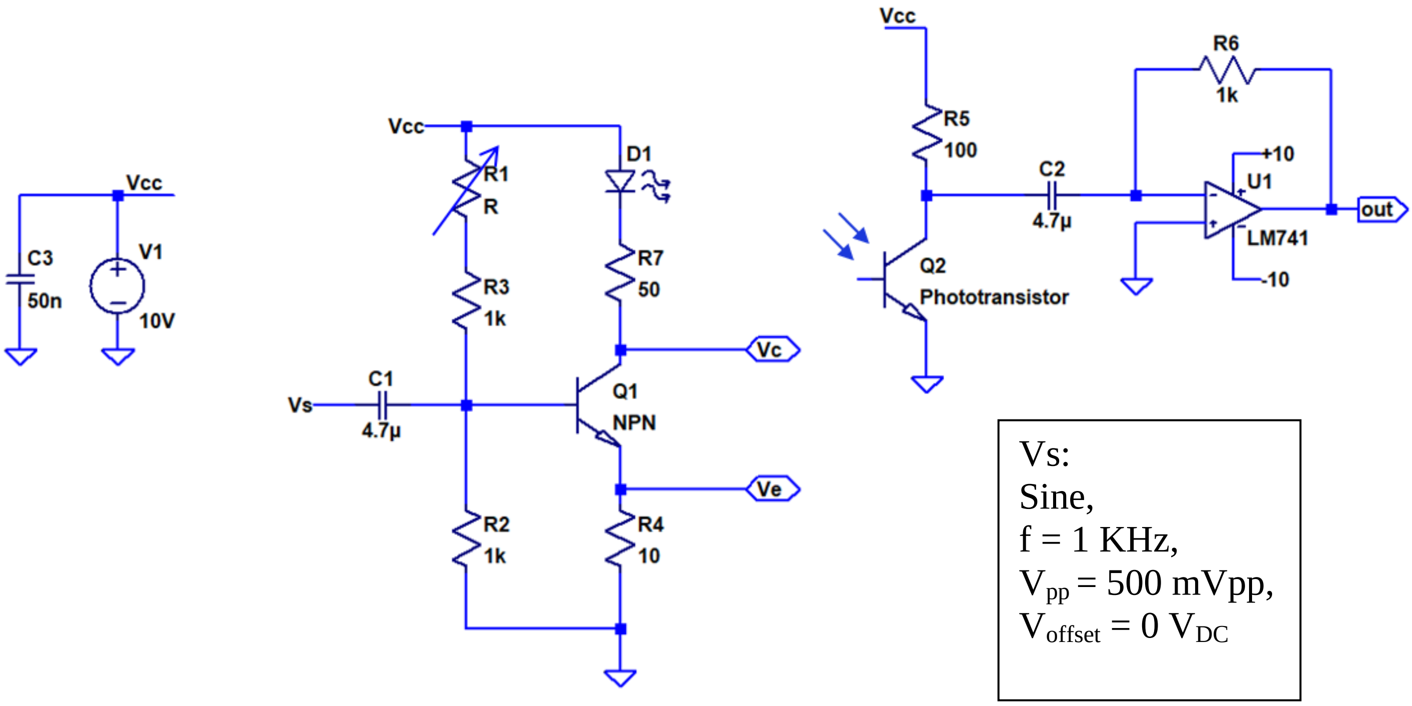
This is a BJT in common emitter configuration, working as an amplifier.

Vout is given by the following formula:

$$Vout = Vin \times \frac{-R_L}{R_E}$$

From this formula, we can see that varying β values will not affect the gain of the circuit if we swap out the 2N3904 for a different npn BJT.

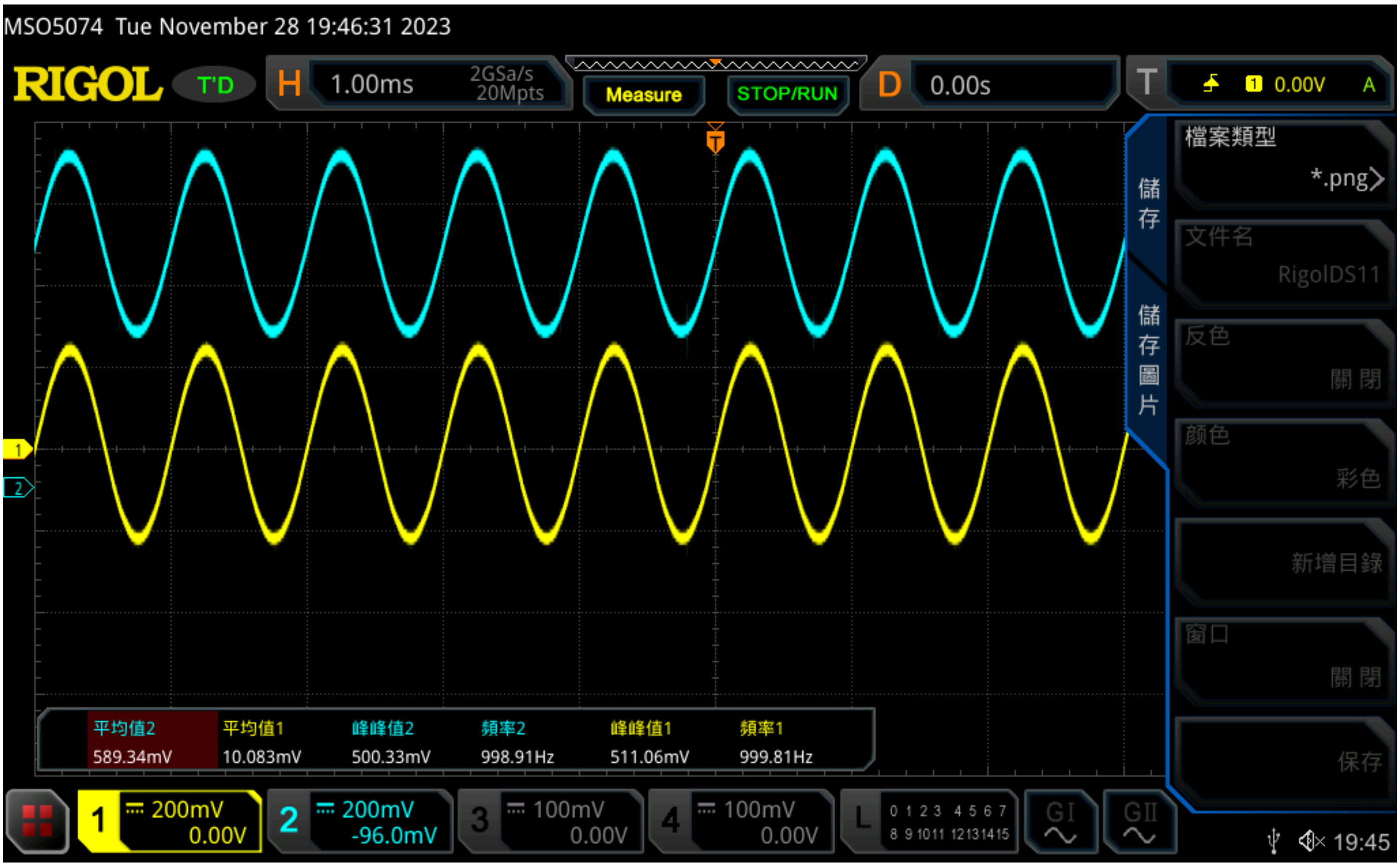
Experiment 3: IR Transmitter / Receiver



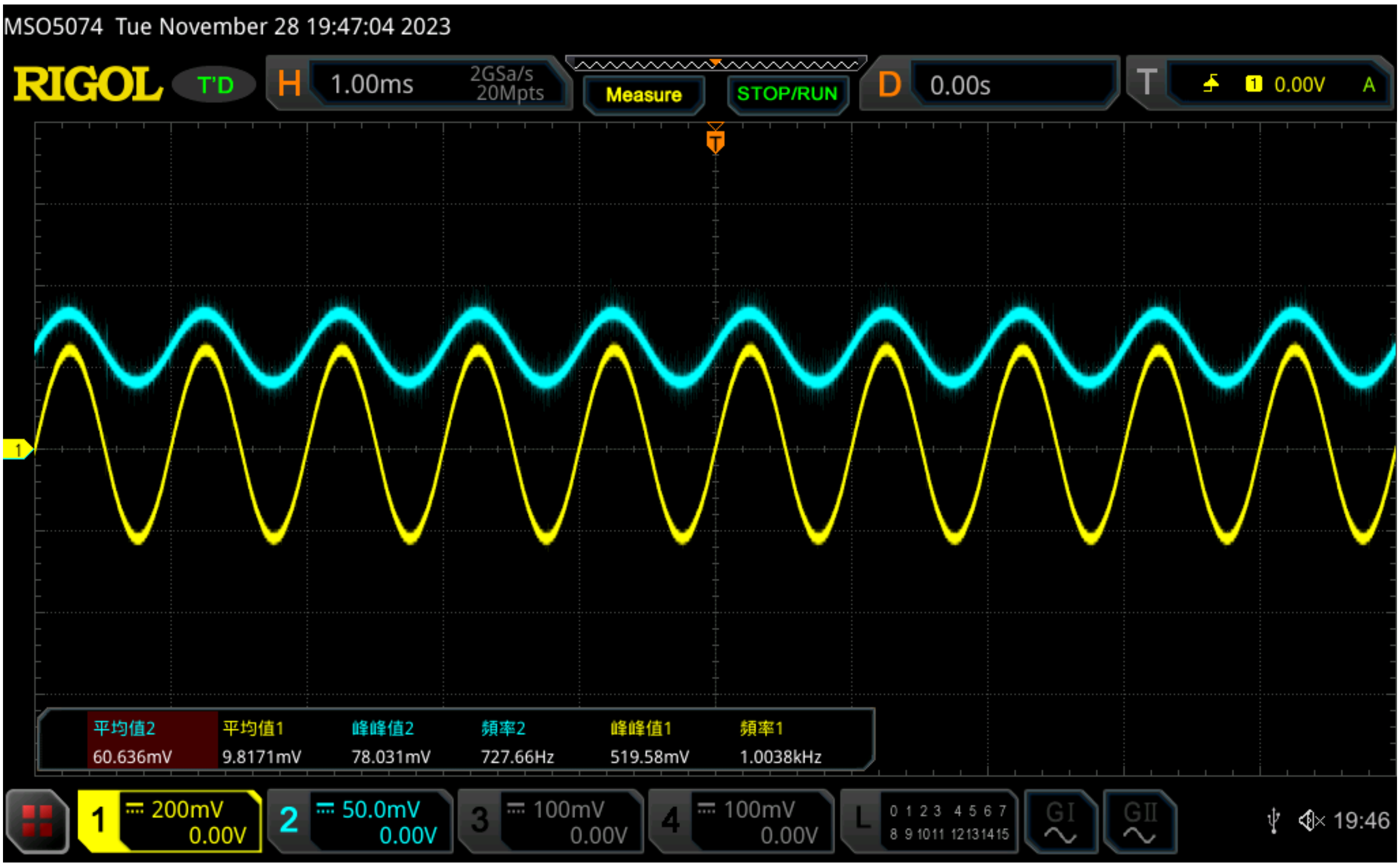
Vs:
Sine,
f = 1 KHz,
V_{pp} = 500 mVpp,
V_{offset} = 0 V_{DC}

V_B (V)	V_C (V)	V_E (V)	Vs,pp(V)	Ve,pp(V)	Vout,pp(V)
1.24	**6.01**	**0.59**	**511.06m**	**500.33m**	**78.031m**

Vs and Ve waveform



Vs and out waveform



IR Transmission Process:

Modulation (Transmitter: IR LED)
The LED's sinusoidal input signal causes it to send out IR light of varying intensity. The LED's brightness changes in accordance with the sine waves amplitude.

Demodulation (Receiver: Photodiode)
When the photodiode is exposed to infrared light, generates a current proportional to the intensity of the received light. This allows our input signal to travel wirelessly.

Amplification (LM741)
The current generated by the photodiode is typically very small. Therefore, an amplification stage in the circuit boosts this weak signal to a usable level. Then, the signal is passed on to the rest of the circuit.

Why are remotes in our daily lives still able to function without being directly aimed at their target device?

- **Wide Angle Coverage:** Some remote controls have wider angle infrared LEDs or use diffusers to emit signals over a broader range. This design allows signals to bounce off walls or objects, reaching the receiver even if the remote isn't pointed directly at it.
- **Reflections and Bouncing:** Infrared signals can bounce off walls, ceilings, or other surfaces in a room. This bouncing effect can sometimes redirect the signals toward the receiver, even if the remote isn't aimed directly at the device.
- **Signal Strength:** Remote controls often emit infrared signals with sufficient power to reach the receiver even if the line of sight isn't perfect. This extra power helps ensure that the signal can still reach the device within a certain range or angle.

References:

1. Electronics Tutorial – Common Emitter Amplifier: https://www.electronics-tutorials.ws/amplifier/amp_2.html
2. Tutorialspoint -What is infrared transmission: https://www.tutorialspoint.com/what-is-infrared-transmission
3. Lifewire – What is an IR remote control: https://www.lifewire.com/what-is-an-ir-remote-control-5194485