BJT Amplifier Temperature Dependence Analysis

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1. Aim of the Project

• Simulate a BJT amplifier circuit in LTSpice to study temperature effects
• Measure AC voltage gain at low-distortion (low-temperature) conditions
• Analyze waveform distortion caused by temperature variations (-10°C to 110°C)

2. Components Used

Component	Value/Model	Role
Transistor (Q1)	BC547C (npn)	Amplification
Resistors (R1,R2)	1MΩ, 100kΩ	Bias network
Resistor (R3)	5kΩ	Collector load
Capacitors (C1,C2)	100µF	Coupling
Voltage Source	10V DC	Power supply
Input Signal	SIN(0 0.01 10k)	10mV, 10kHz sine wave

3. Simulation Setup

• Transient Analysis: .tran 0.3m (0.3 milliseconds duration).
• Temperature Sweep: .step temp -10 110 20 (-10°C to 110°C in 20°C steps).

4. Results & Analysis

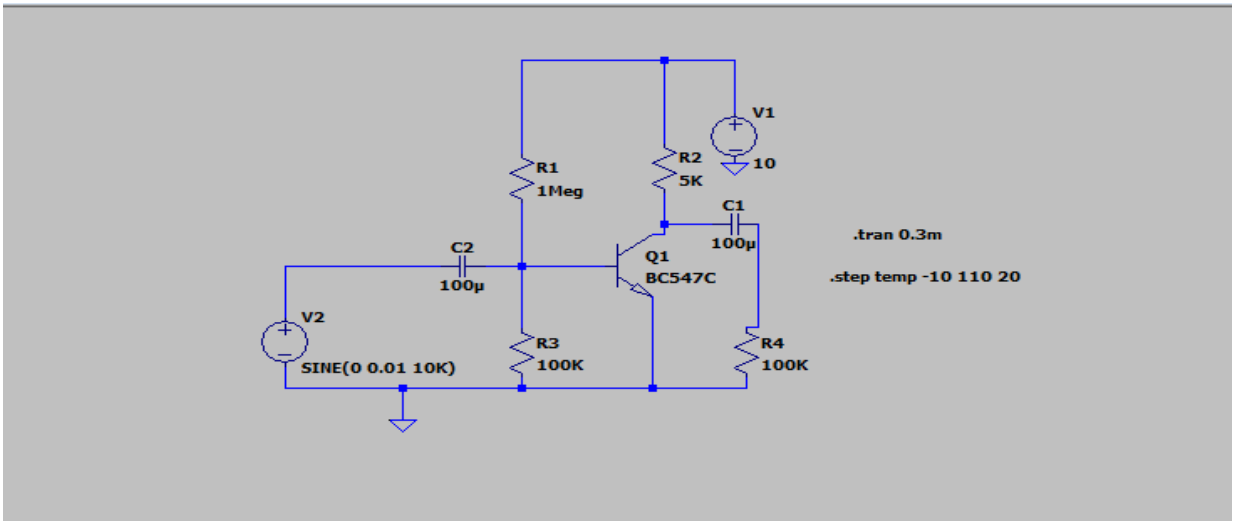

Figure 1:BJT Circuit

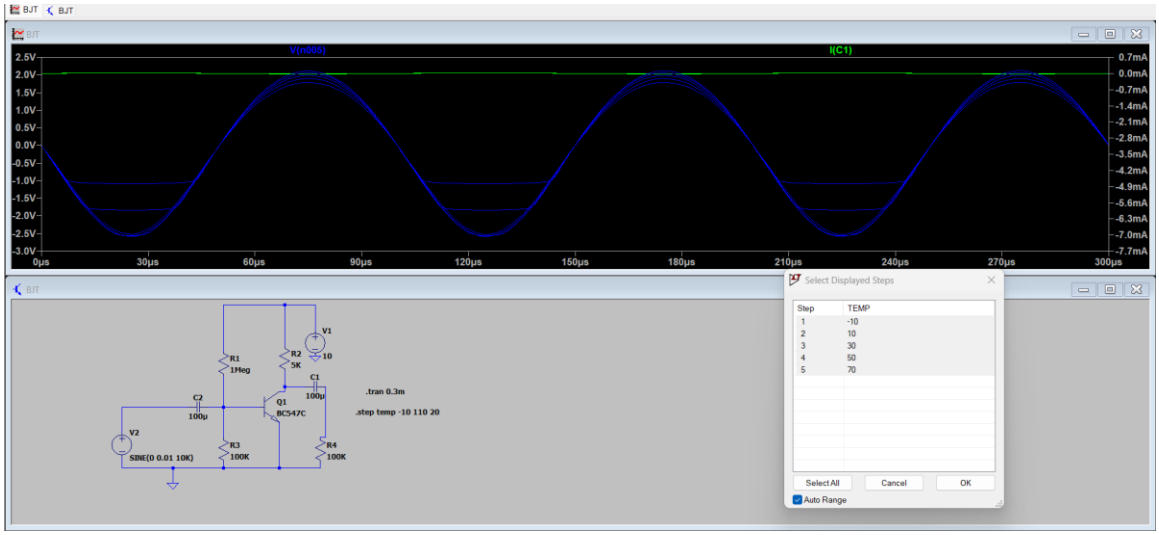

Figure 2: Output

4.1 Temperature vs. Waveform Distortion

The graph shows output waveforms at different temperatures:

• -10°C to 30°C: Clean sinusoidal output (minimal distortion)

• 50°C to 110°C: Increasing distortion (clipping/flattening)

How to verify temperatures in LTSpice:

1. Right-click graph → "View" → "Step Legend"
2. Hover over curves to see temperature values

4.2 AC Voltage Amplification (Task b)

Calculation method:

Av = Vout/Vin = (Peak output voltage)/(10mV input)

Example (at -10°C):

If peak output = 0.5V:

Av = 0.5V/0.01V = 50

5. Discussion

• Low temperatures provide stable operation

• High temperatures cause distortion due to:

- VBE shifts (~2mV/°C)
- β (current gain) variations
- Increased leakage currents

6. Conclusion

The BJT amplifier shows:

- Voltage gain ≈ 50 at low temperatures
- Significant distortion above 70°C
- Temperature dependence of BJT parameters affects performance

Final Answer to Task b:

The approximate AC voltage amplification is 50, measured at -10°C where distortion is minimal.