- v or i represent small signals or variations about a mean DC operating point of value V or I.

- A small signal applied to a transistor causes the instantaneous operating point to move along a load line.

- The amplification is represented by A.

- A negative sign for A implies that the output signal waveform is inverted.

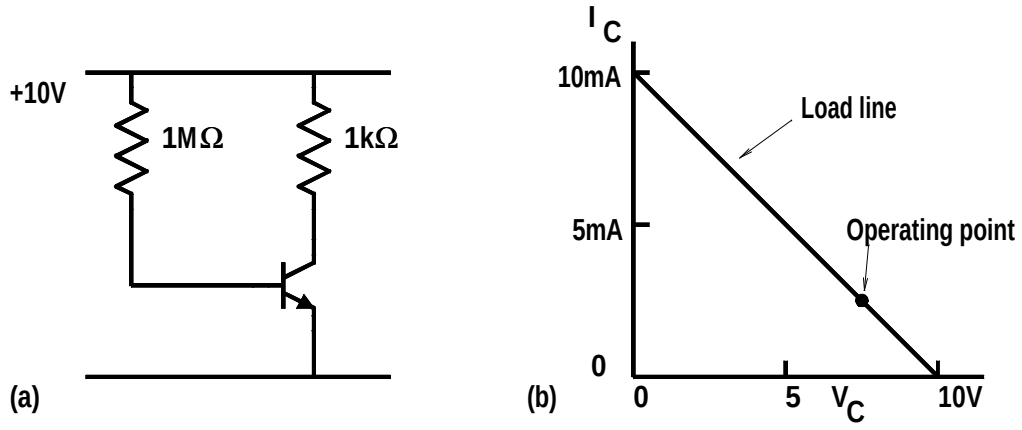
- In a common emitter amplifier, the emitter is common to the input and the output ports for small signals.

- In a common base amplifier, the base is common to the input and the output ports for small signals.

- In a common collector amplifier, the collector is common to the input and the output ports for small signals.

DC bias transistors into the middle of their working range so that
the emitter–base junction is forward biased
the base–collector junction is reverse biased.

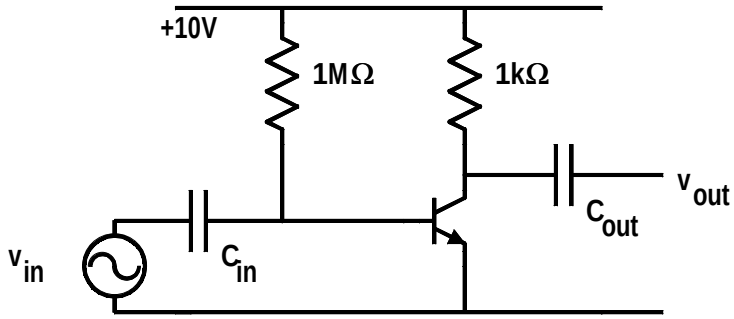
Ways of getting some useful signal gain
Define a small signal as a fluctuation in voltage or current about an operating or bias point
Use lower case i or v to represent these small signals.
Signals are superimposed on the DC bias voltages and currents and modulate them.



Transistor Load Line Unit 31, Example 1 $V_C = 7.7V$ and $I_C = 2.3mA$ Modulate the base current in some way.

$$V_C = V_{supply} - I_C R_C = 10V - I_C \times 1k\Omega$$

to get LOAD LINE When $I_C = 0$, $V_C = 10V$ and
$V_C = 0$ and $I_C = \frac{10V}{R_C} = 10mA$.
Any variation in signal to the base only causes the (V_C, I_C) values to move up or down along this load line.



Method of coupling in small signals

Bias the transistor so that it is at operating point towards the middle of load line

Superimpose small variation on the base current or voltage of the transistor to cause operating point to vary along the load line.

Use a capacitor to couple in the signal.

Review Unit 27, Example 2, which shows a similar example of superposition for a diode circuit.

- Increased base voltage causes increased base current.

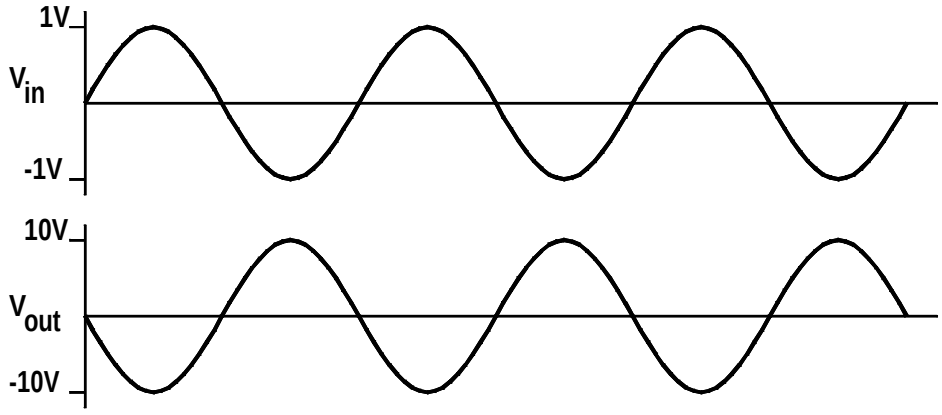
- Base current amplified by the transistor by β, gives a larger emitter current.

- Emitter current gives a nearly equal change in collector current.

- The increased collector current gives an increased voltage drop across the collector resistor, R_C.

- Voltage drop across the collector resistor gives decrease of collector voltage.

- Decrease in collector voltage gives signal inversion

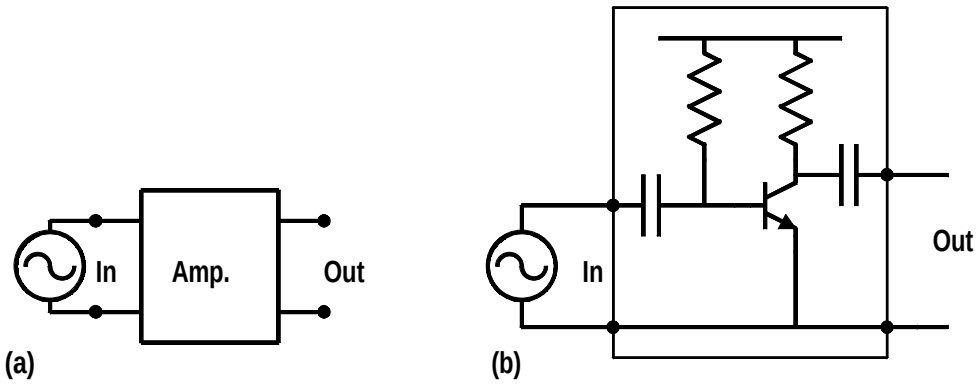


Oscilloscope trace of input and amplified signals for $A = -10$

v_{out}, may be an inverted and amplified version of the input signal, v_{in}

$$A = \frac{v_{out}}{v_{in}}$$

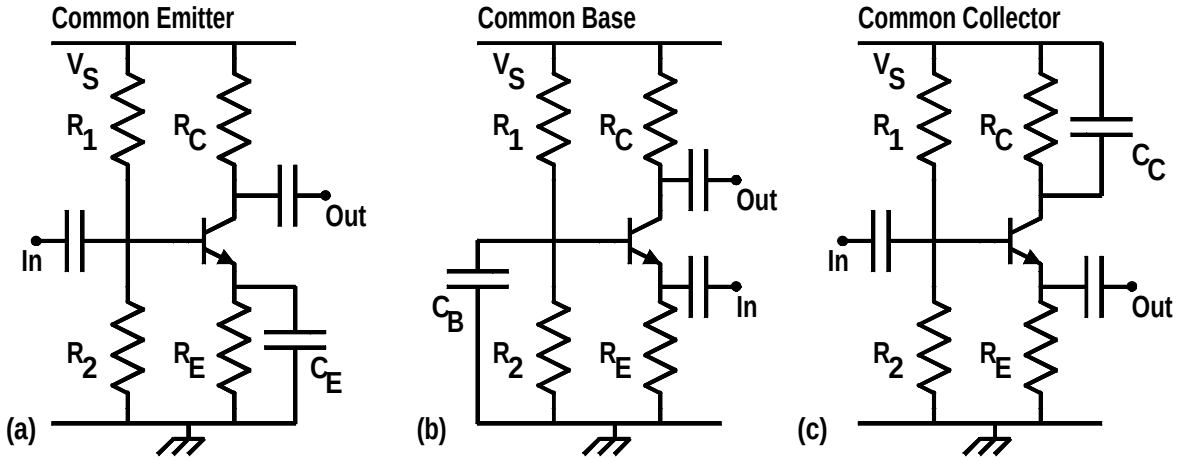
A negative value for A implies signal inversion.



Input signal, v_{in}, is applied via two wires

Output signal, v_{out}, is taken out via two wires.

Amplifier is a two port device



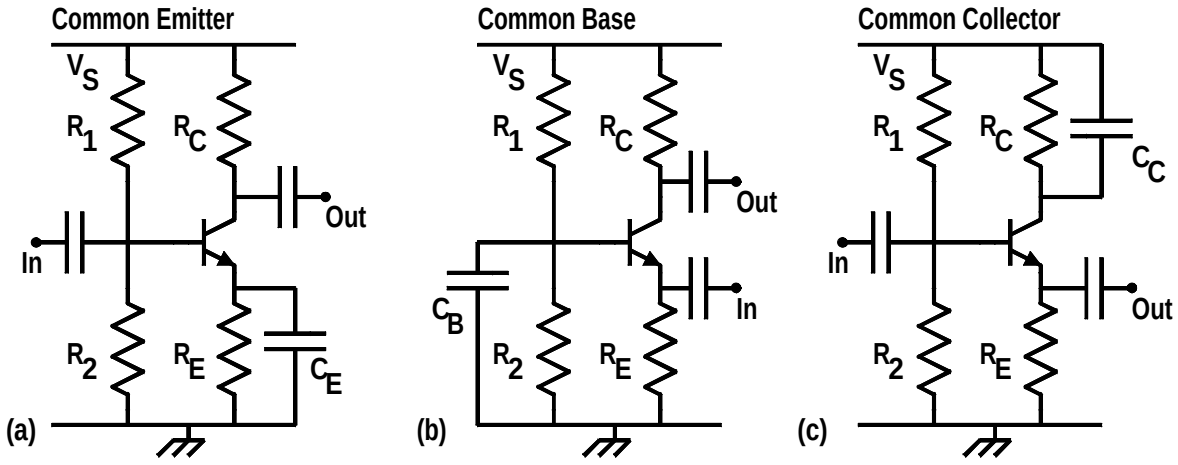
Transistors have only three connections

One of transistor connections must be common to both input and output ports

Common transistor terminal is the emitter.

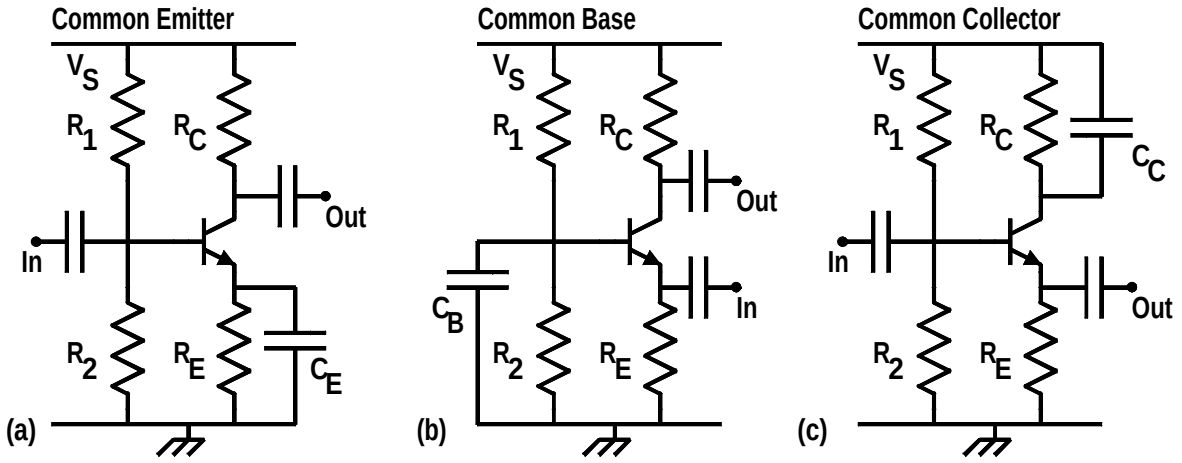
This amplifier called Common Emitter Amplifier.

Only common to the input and output for small signals.

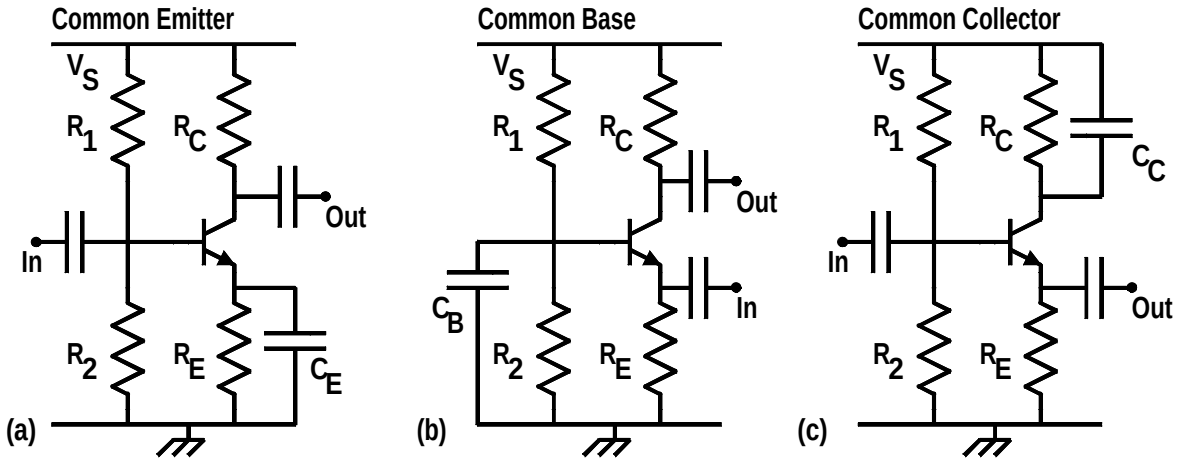


Common Emitter in (a) the emitter is grounded via the C_E so the emitter voltage does not vary

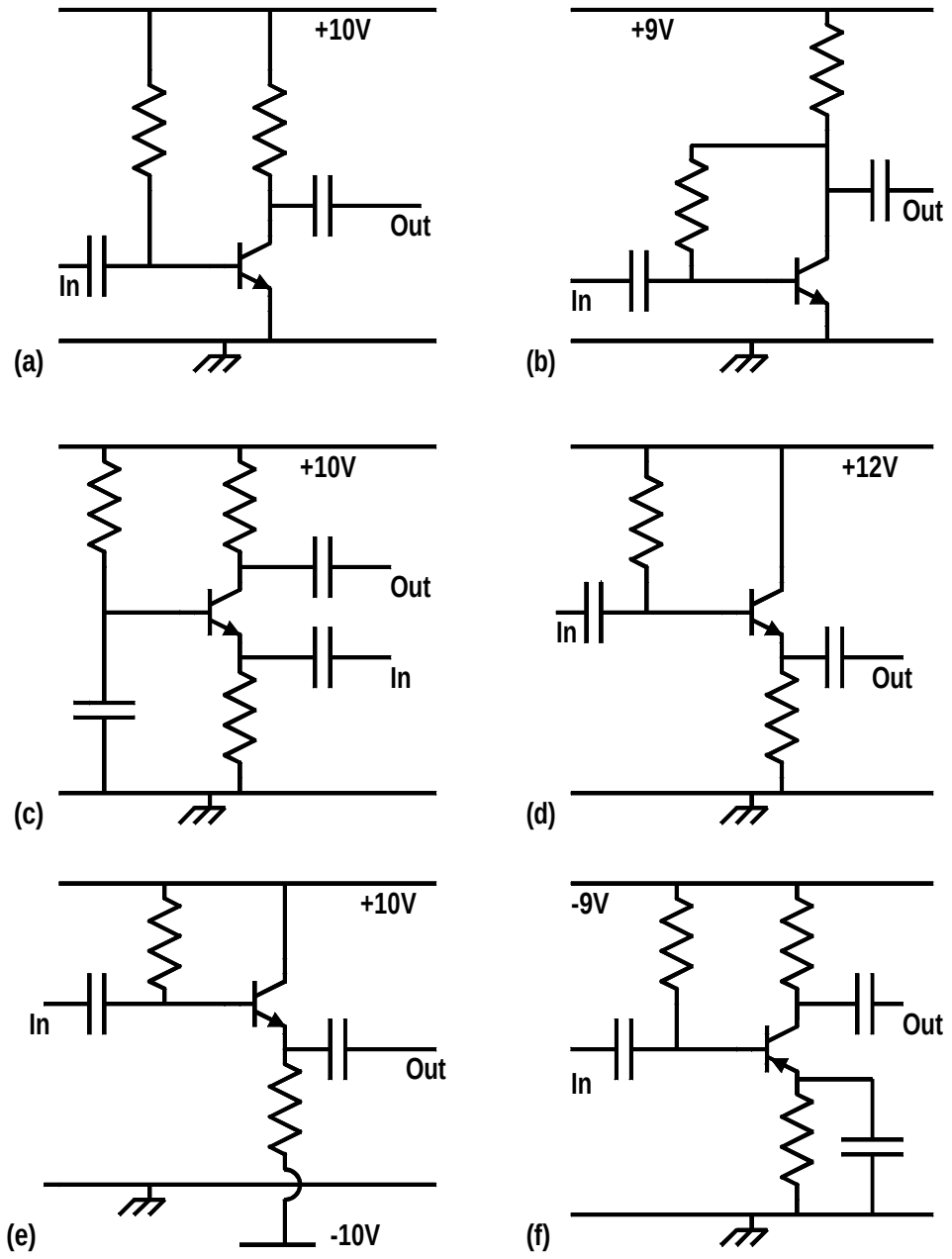
The input signal is applied to the base and the amplified signal is taken from the collector.



Common Base Amplifier in (b),
Base grounded for small signals via the C_B.
Input signal is applied at the emitter. A positive going input signal causes the V_{BE} to reduce thus reducing the emitter and collector currents in the transistor. This gives an increase in the collector voltage and therefore the sign of the amplification, A, is positive denoting no inversion.
Applications in high frequency and in radio frequency amplifiers.



Common Collector Amplifier in (c)
Collector grounded via C_C
Positive signal to base causes base current and emitter current to increase.
Increased voltage across the R_E and emitter voltage follows the base voltage.
Sometimes called an Emitter Follower.
Amplification of this circuit is $+1$ or less
Used in input stages for high input impedances and output stages for low output impedance



Problem 3. Identify the circuit type