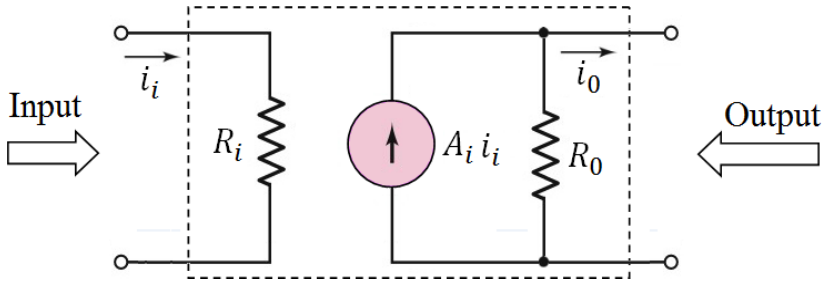
Current Amplifier

An equivalent circuit of a current amplifier is shown in below. This amplifier is mainly used to amplify the current. The input parallel resistance of the amplifier is very low and the output parallel resistance is very large, these characteristics are essential for a current amplifier. The current gain of the amplifier is defined as the ratio between output current and input current, mathematically

$$A_i = i_0 / i_i$$

The gain of a current amplifier is unit less. (There is no unit)



Equivalent circuit of a current amplifier

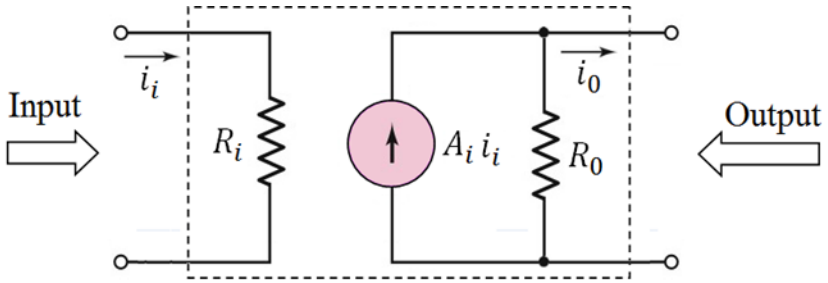
Example 1: The output short circuit current of a current amplifier is 255.0mA when its input is connected to a current source. If the current gain of the amplifier is -50 then determine the input current of the amplifier.

Solution: Here, $i_0 = 255\ mA$ and $A_i = -50$

The current gain,

$$A_i = \frac{i_0}{i_i} = -50$$

Therefore, $i_i = \frac{i_0}{-50} = -\frac{255mA}{50} = -5.1mA$

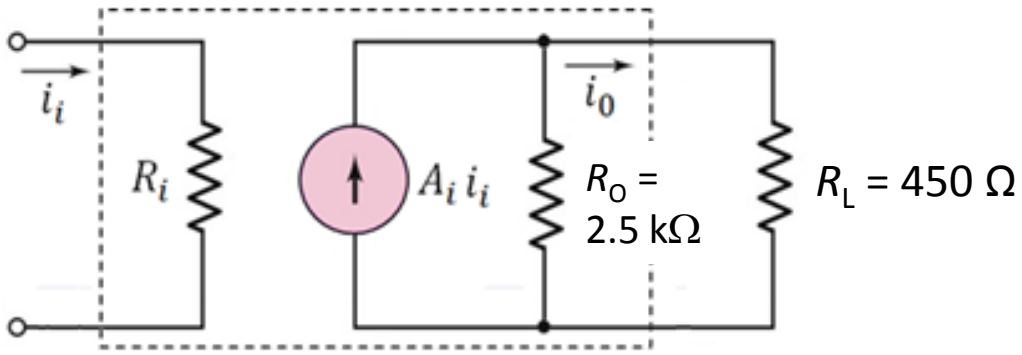


Equivalent circuit of a current amplifier

Example 2:

The short circuit current gain and output resistance of a current amplifier is 30 and 2.5kΩ respectively. Determine the output voltage when its output is connected to a load resistance of 450Ω.

The input current, i_i is 0.5 mA

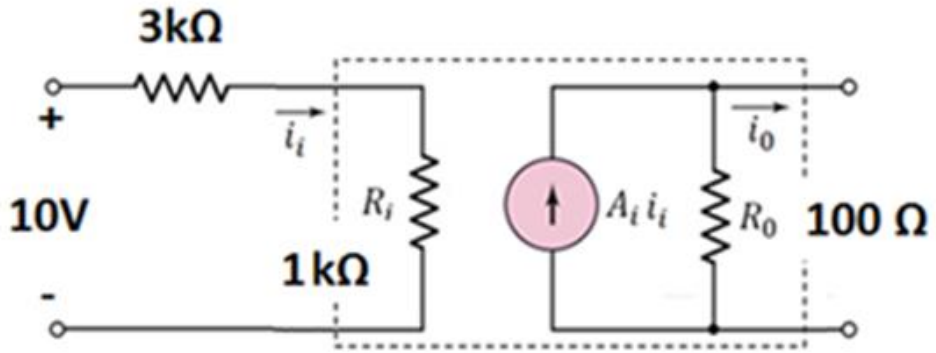


1. Calculate the value of the short circuit current, $A_i\, i_i$
2. Use current divider to calculate i_o
3. Use Ohm's Law to find output voltage.

Answer: 5.72 V

The short circuit current of a current amplifier is 100 mA when its input is connected to a signal source. The voltage of the signal source is 10 V and its resistance is 3 kΩ. The input and output resistances of the amplifier are 1 kΩ and 100 Ω respectively.

a) Draw the schematic of the amplifier circuit including the source.
b) Calculate the short circuit current gain of the amplifier
c) Determine the output current and voltage of the amplifier when a 25 Ω load resistor is connected at the output.

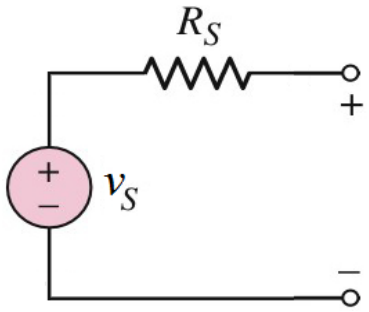


i_o = 100 mA
i_i = 10 / 4k = 2.5 mA
A_i = i_o / i_i = 40

$A_i i_i$ = 100 mA
Current divider : current at load resistor = [100 / 125] (100mA) = 80 mA
Ohm's law: Voltage at the load resistor = 80m (0.025k) = 2 V

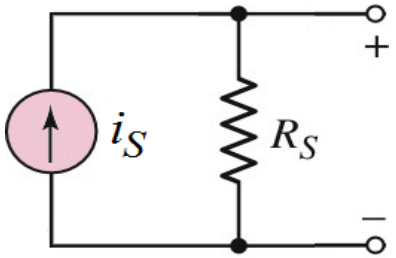
Signal Source or Generator

A voltage source is modeled by a voltage generator with a series resistance called source resistance as shown in bellow. For an ideal voltage source the series resistance is 0. A voltage source can be replaced by an equivalent current source using Norton theorem.



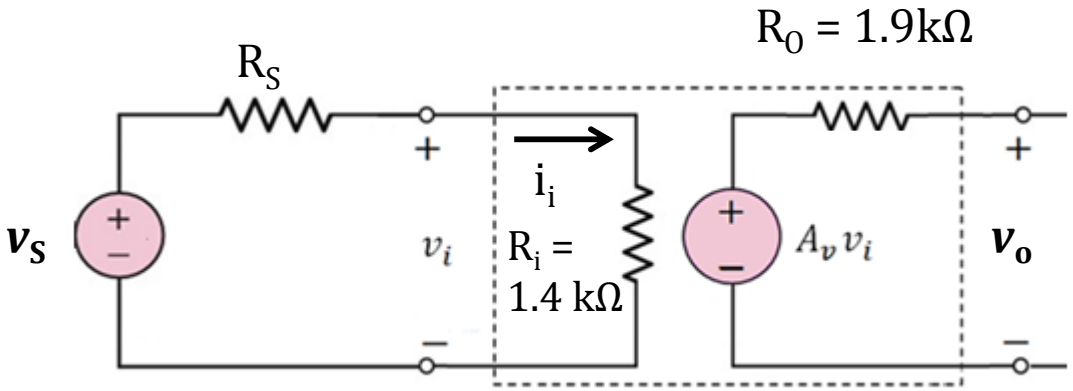
Voltage source

Similarly, a current source is modeled by a current generator with a parallel resistance called source resistance as shown in bellow. For an ideal current source the parallel resistance is infinite. A current source can be replaced by an equivalent voltage source using Thevenin theorem.

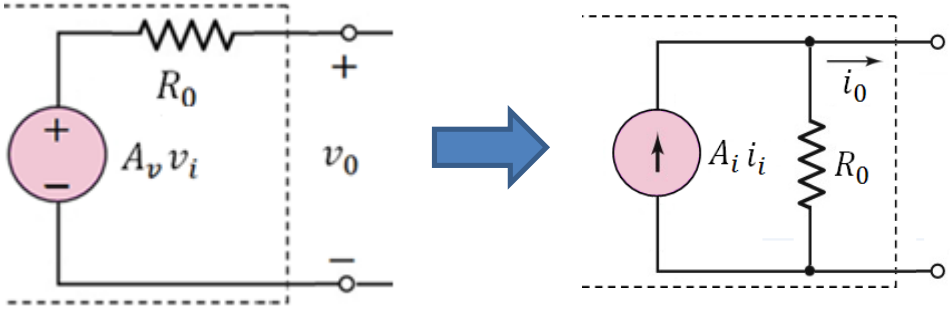


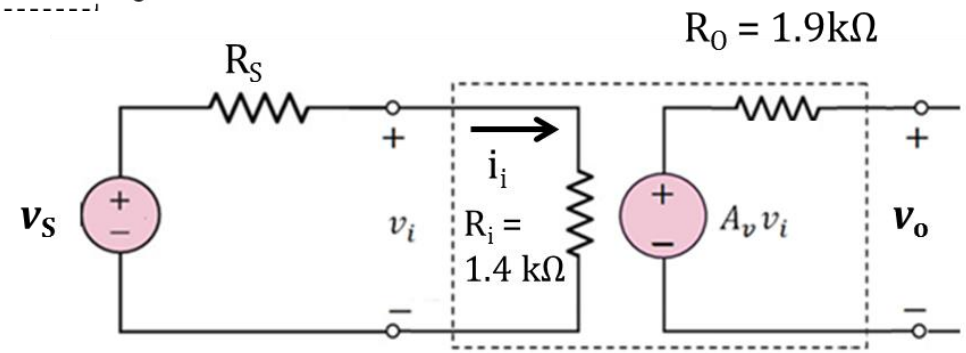
Current source

Example 4:



Calculate the short circuit current gain, A_i given that the open circuit voltage gain, A_v = 127.9





Using source transformation:

$$A_i i_i = \frac{A_v v_i}{R_O}$$

$$But\ i_i = \frac{v_i}{R_i}$$

$$So\ A_i \frac{v_i}{R_i} = \frac{A_v v_i}{R_O}$$

$$A_i = \frac{A_v R_i}{R_O} = 127.9\left(\frac{1.4}{1.9}\right) = 94.24$$