Feedback Amplifiers

Classification of Basic Amplifiers

The basic amplifiers are normally classified into four categories based on the magnitudes of the input and output impedances of an amplifier, with respect to the source and load impedances. These basic amplifiers are used in feedback amplifiers.

1. Voltage Amplifiers
2. Current Amplifiers
3. Transconductance Amplifier
4. Transresistance Amplifier

1. Voltage Amplifier

A voltage amplifier is represented by a two-port network. It is driven by a voltage source V_s with source resistance R_s. An external load resistance R_L is connected across the output terminals.

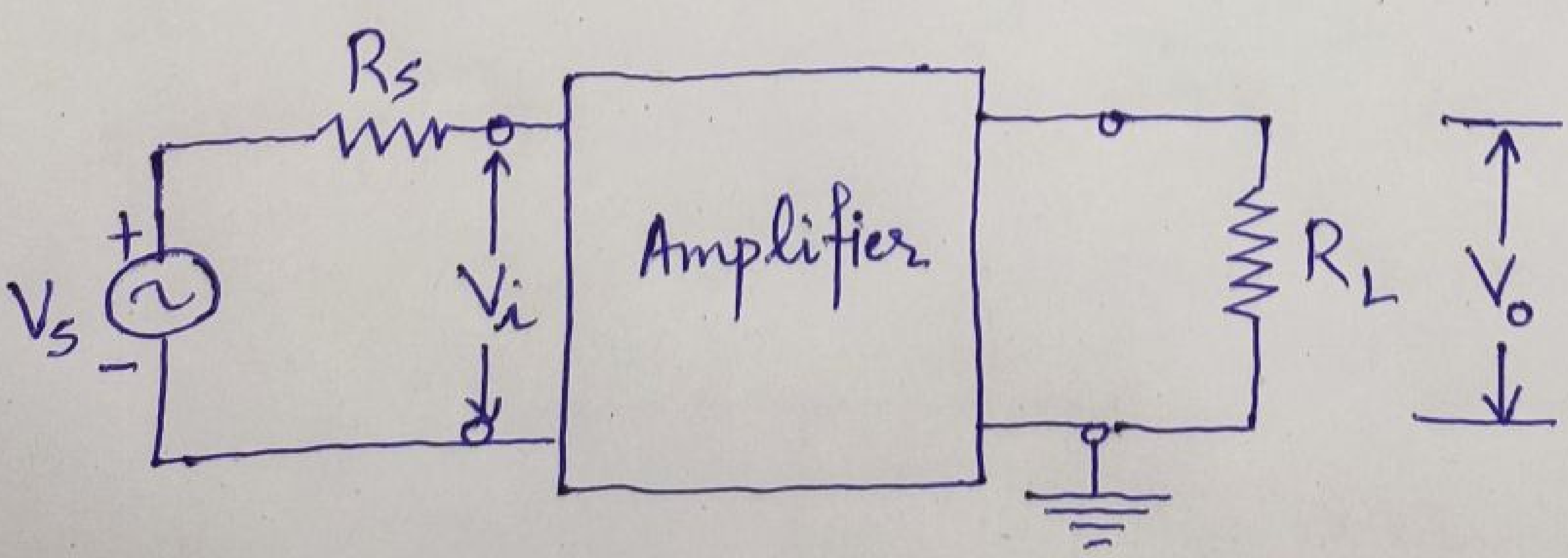

Fig. 1. (a) Basic Voltage Amplifier

Figure 1. (b) shows a Thevenin's equivalent circuit of a voltage amplifier.

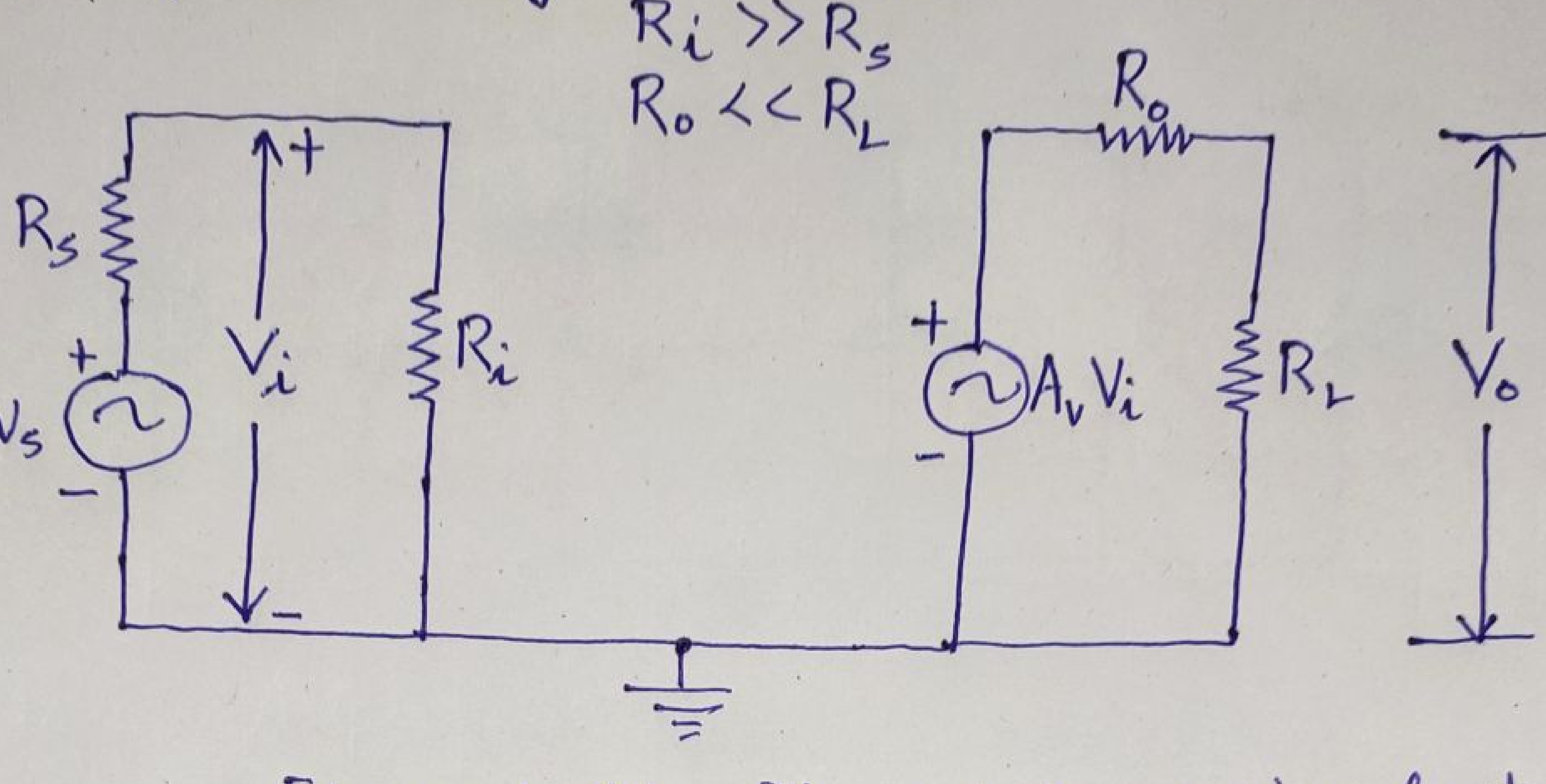

Figure 1. (b). Thevenin's equivalent

Since, $R_i >> R_s$, then $V_i \approx V_s$.

Also, $R_L >> R_o$, then $V_o \approx A_v V_i \approx A_v V_s$

{ Note: R_i = Amplifier input resistance
R_o = Amplifier output resistance }

An ideal voltage amplifier must have infinite input resistance R_i and zero output resistance R_o. 'A_v' represents the open-circuit voltage gain with $R_L = \infty$.

2. Current Amplifier

A current amplifier is represented by a two port network. It is driven by a current source I_s with source resistance R_s.

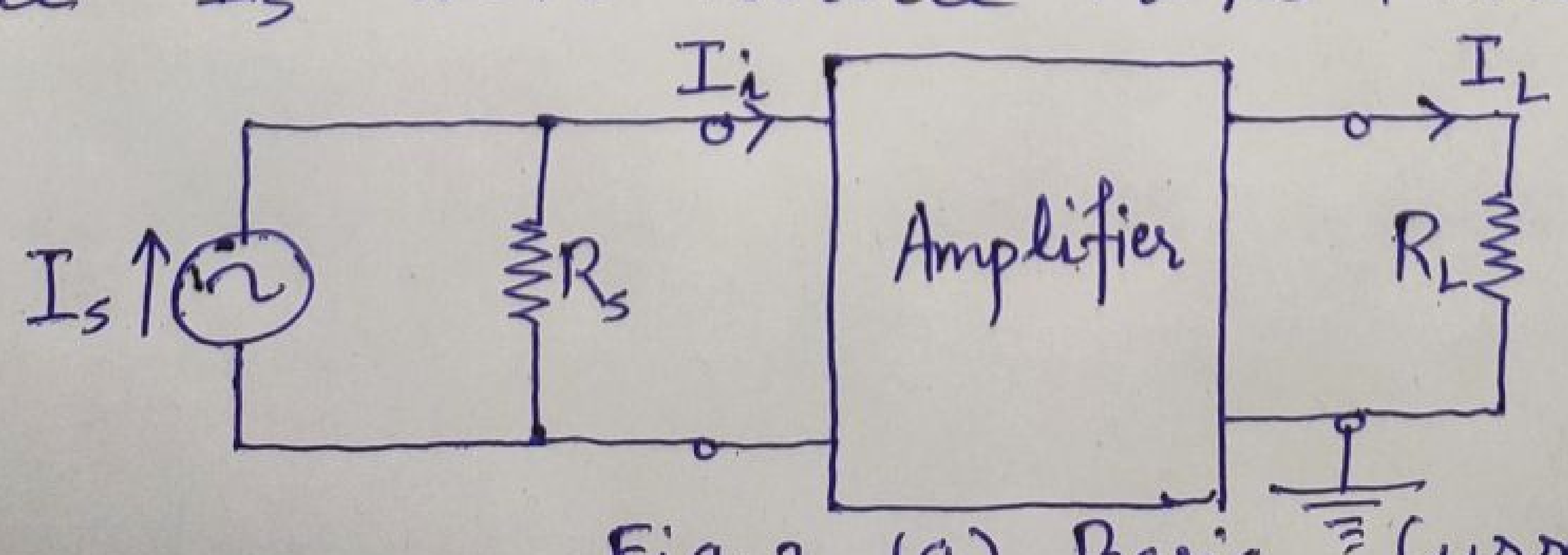

Fig. 2. (a) Basic Current Amplifier

Figure 2 (b) shows a Norton's equivalent circuit of current amplifier.

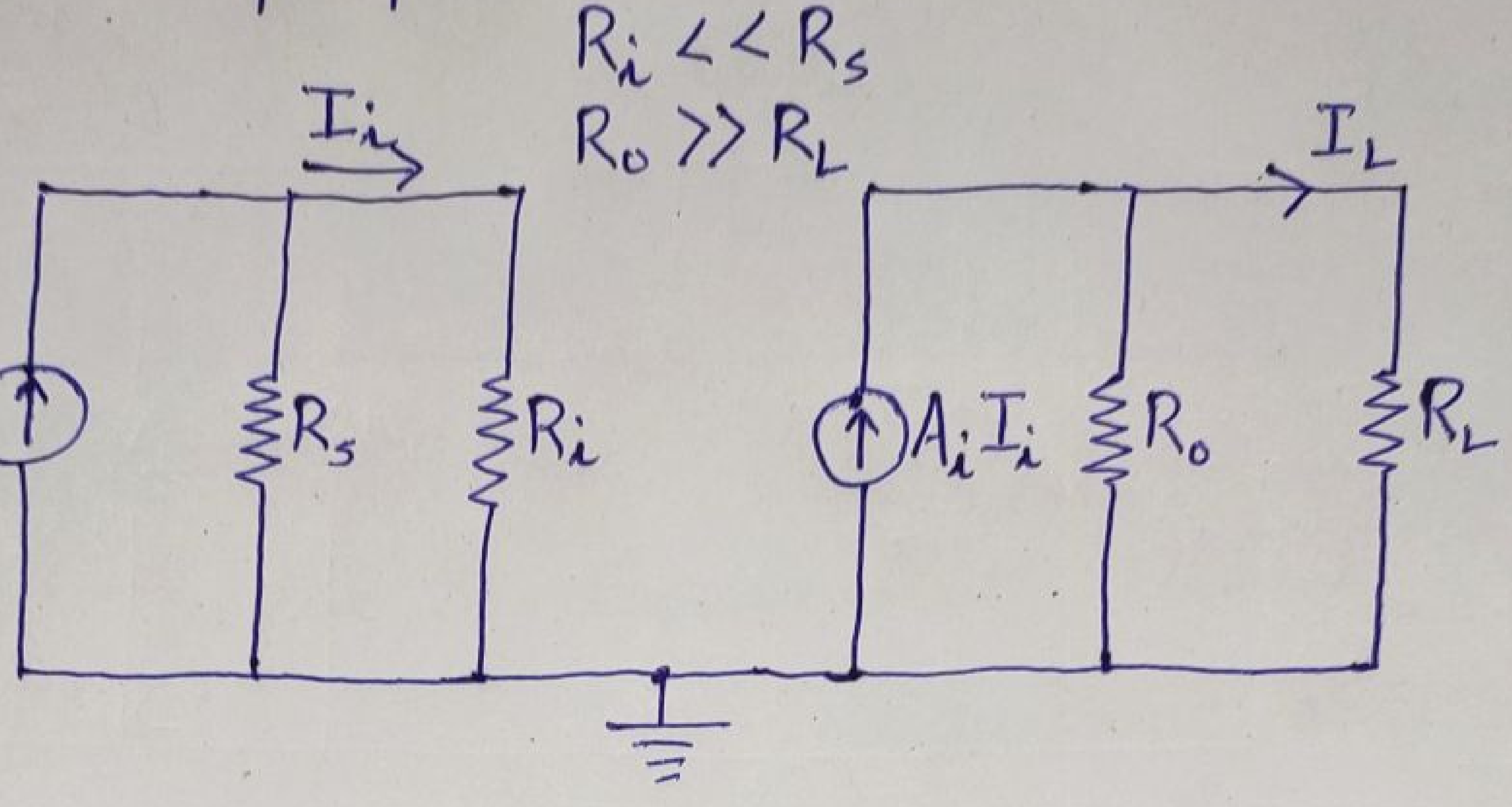

Figure 2 (b). Norton's equivalent

Here A_i represents short-circuit current gain with $R_L = 0$.

$$\therefore \quad A_i \approx \frac{I_L}{I_i}$$

In practice, the current amplifier has low input resistance and high output resistance.

i.e $\quad R_i << R_s \quad$ and $\quad R_o >> R_L$

An ideal current amplifier must have zero input resistance(R_i) and infinite output resistance R_o.

3. Trans conductance Amplifier

Figure 3. shows the equivalent circuit of a trans conductance amplifier in which source is represented by its Thevenin's equivalent and amplifier is represented by its Norton's equivalent circuit.

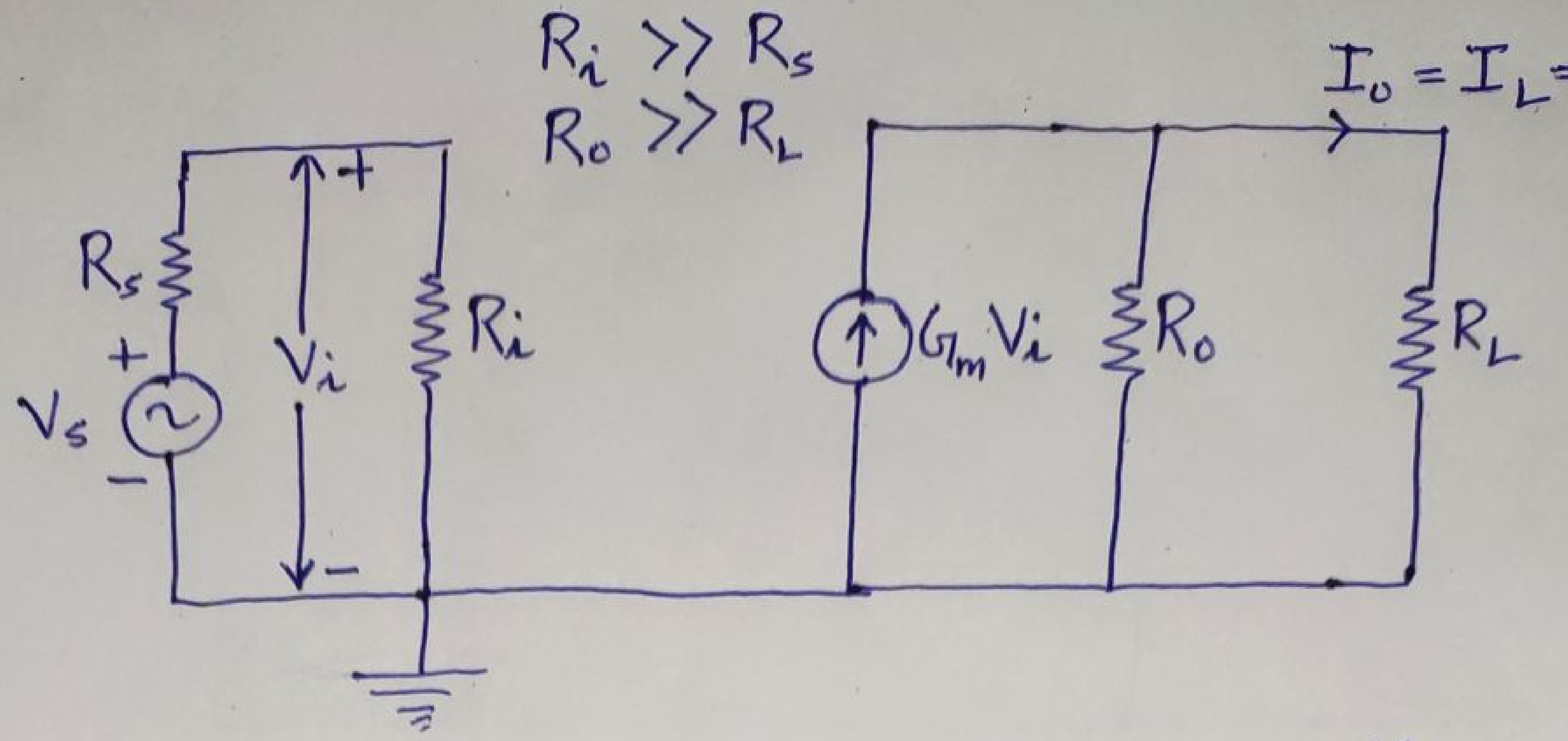

Figure 3. Equivalent Circuit for Transconductance amplifier

An ideal transconductance amplifier provides an output current which is proportional to the input signal voltage and is independent of R_s and R_L. The ideal transconductance amplifier must have $R_i = \infty$ and $R_o = \infty$.

$$\therefore \quad I_L \approx G_m V_i \approx G_m V_s$$

where 'G_m' represents the short circuit mutual conductance or transfer conductance.

Note that for transconductance amplifier,

$$R_i >> R_s \text{ and } R_o >> R_L .$$

4. Transresistance Amplifier

Figure 4. shows the equivalent circuit of a transresistance amplifier in which source is represented by its Norton's equivalent and amplifier is represented by its Thevenin's equivalent.

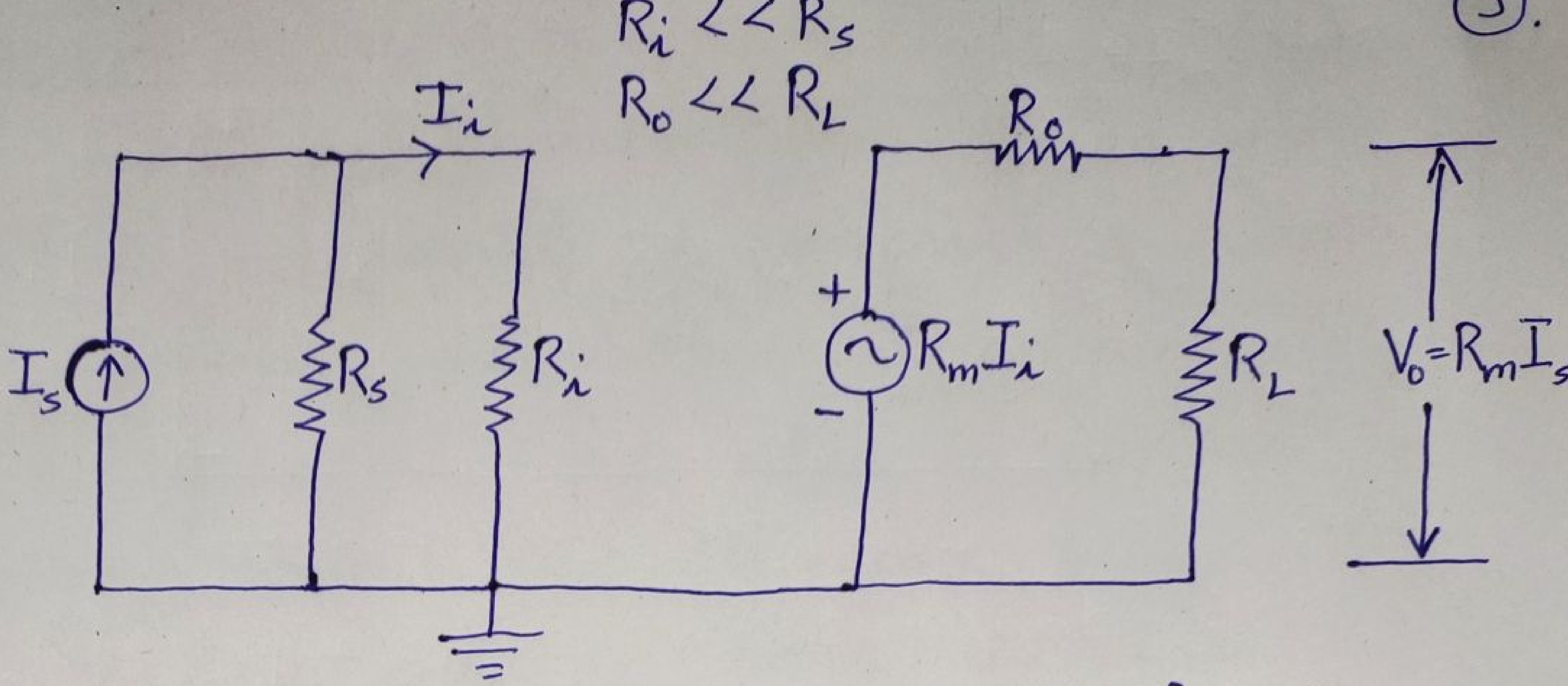

Figure 4. Equivalent circuit for Transresistance amplifier

The output voltage V_o is proportional to the signal current I_s, independent of the magnitudes of R_s and R_L.

Since $\quad R_s >> R_i, \quad I_i \simeq I_s.$

Also $\quad R_o << R_L$, then $V_o \simeq R_m I_i \simeq R_m I_s$

Note that, $\quad R_m = \dfrac{V_o}{I_i}$ with $R_L = \infty$

where 'R_m' is the open-circuit transfer resistance.