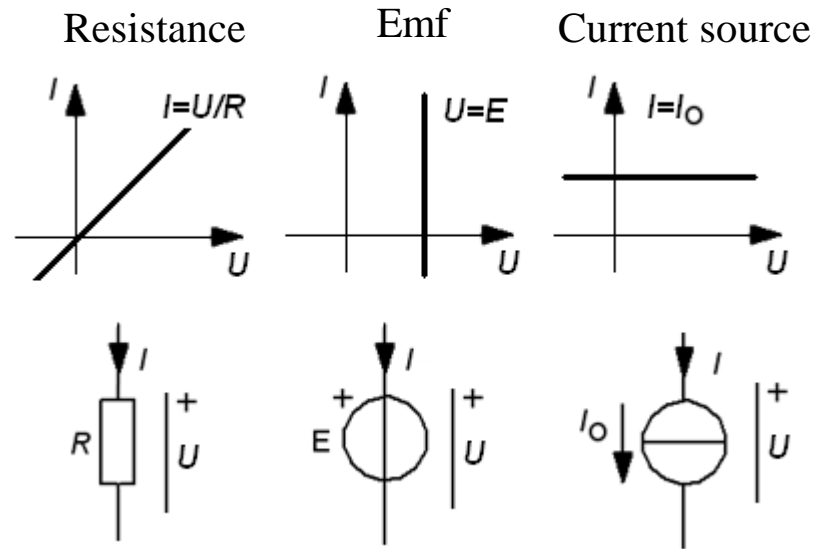


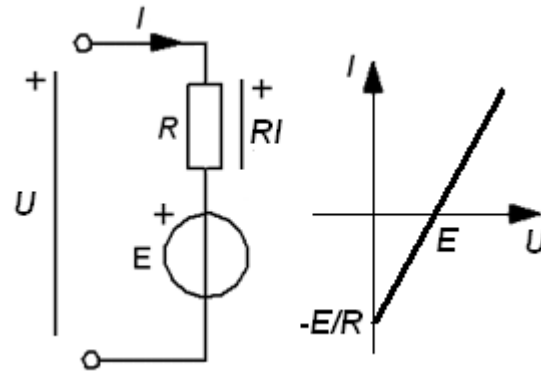
Circuit elements in graphical form



With this polarity definitions the elements receive power when the U and I are positive.

(Emf and Current generator are being "charged")

Two-terminal circuit with emf and resistance

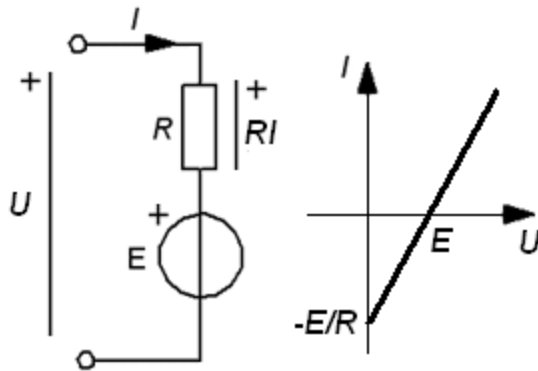


$$U = E + R \cdot I \text{ or } I = (U - E) / R$$

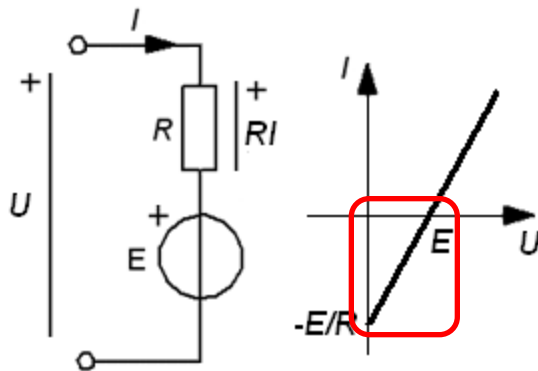
When $U > E$ will I be positive. The circuit receives power.

When $U < E$ will I be negative. The circuit delivers power.

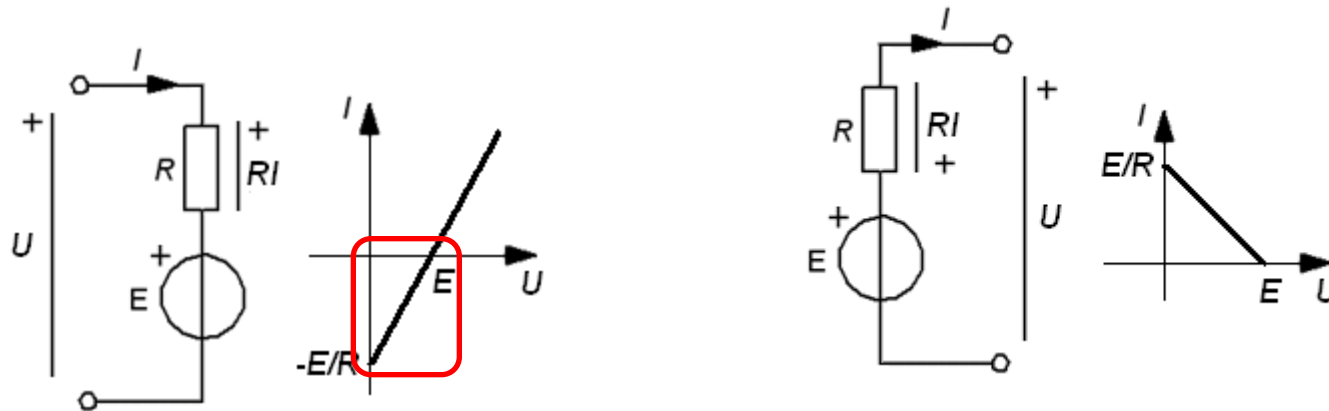
Two-terminal circuit with emf and resistance



Two-terminal circuit with emf and resistance

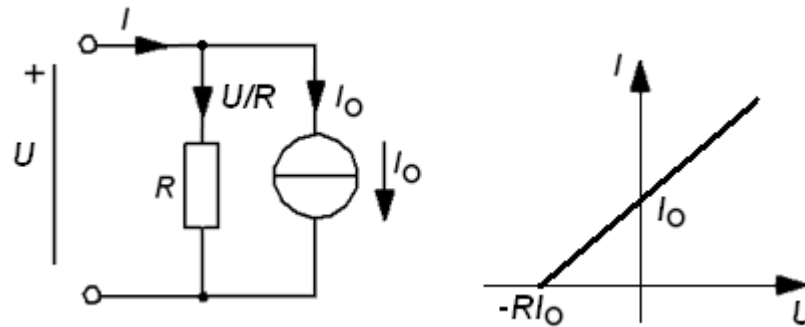


Two-terminal circuit with emf and resistance



Circuit delivers power. Then it is convenient to define the current in the opposite direction.

(Current source and resistance)

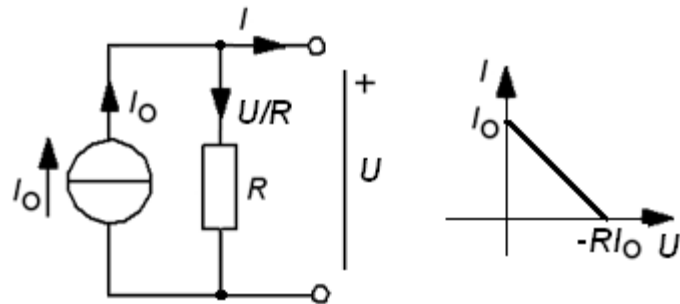


$$I = U/R + I_0$$

If $U > 0$ the circuit is receiving power.

When $U < 0$ the circuit is delivering power.

(Current source and resistance)



The circuit is delivering power.

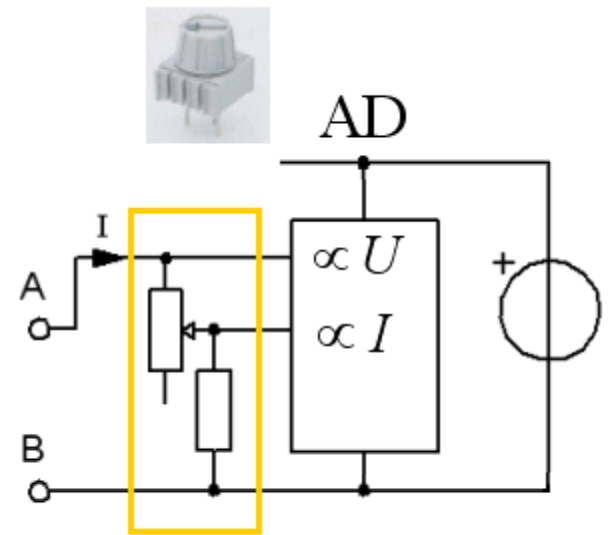
Then it is convenient to define the current in the opposite direction.

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Measurements at the AD-Lab

At lab vi are loading two different two-terminal circuits with a variable resistor, $100 \Omega \dots 1k \Omega$. We measure the associated values of voltage U , and current I (indirectly as voltage drop over a constant 100Ω resistor) with two of the AD-converter channels. Measured values are stored in a file and presented with excel.

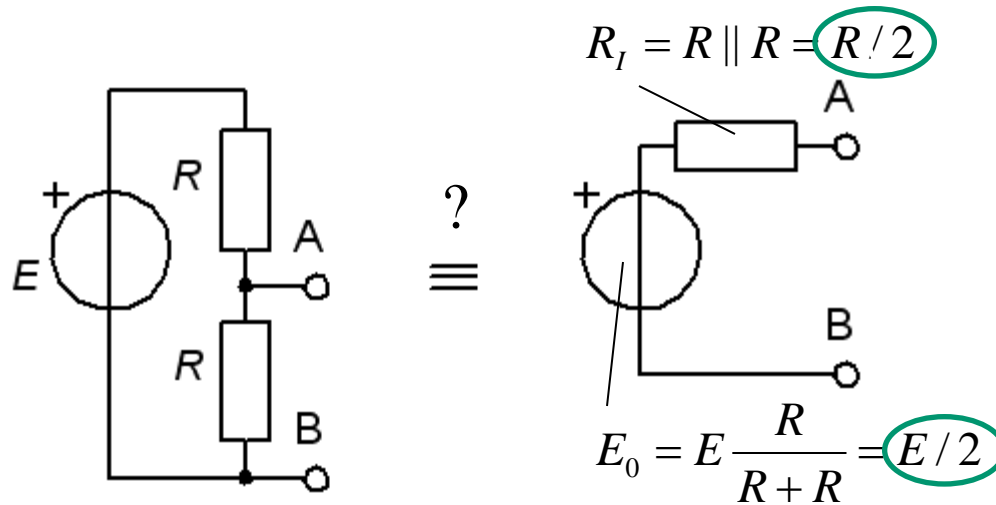
Measuring equipment



Variable resistor load

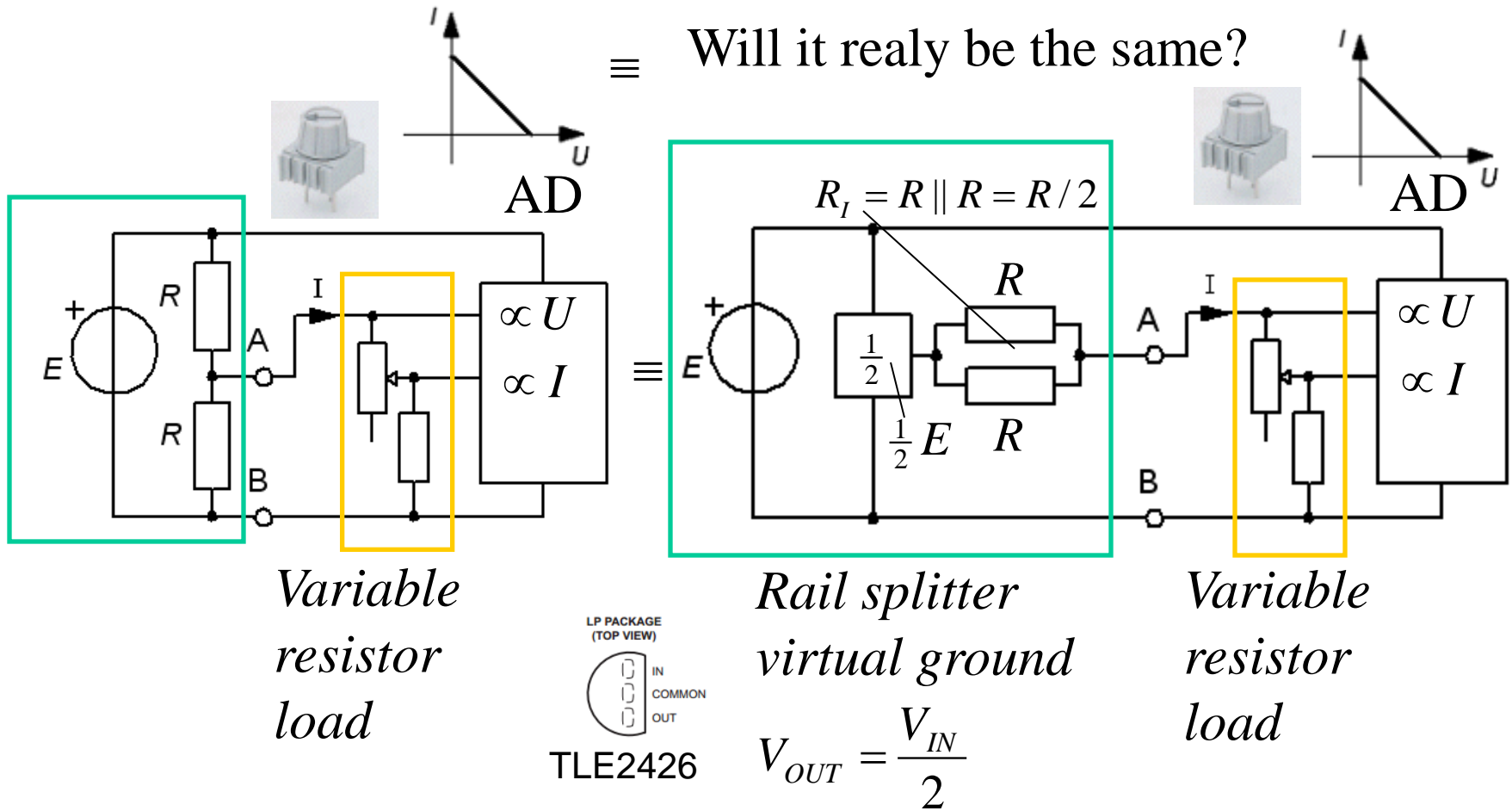
Are 2-terminal equivalents true?

Thevenin theorem says:



Is this correct?

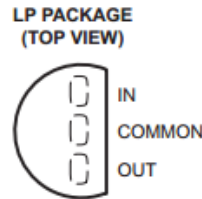
Measurements on two-terminal circuits



Rail splitter virtual ground?



TLE2426

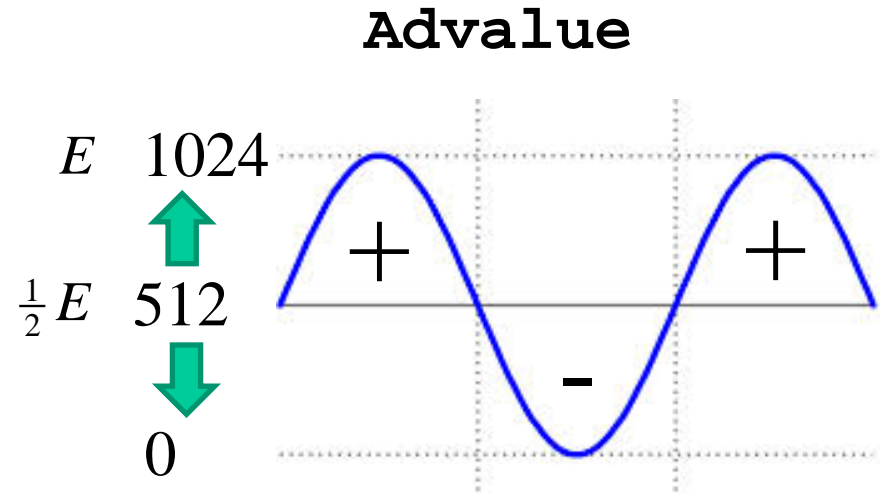
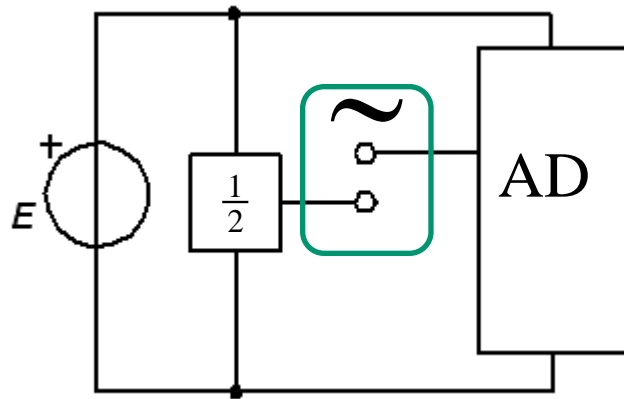


$$V_{OUT} = \frac{V_{IN}}{2}$$

This circuit contains a control system which "tries" to keep the output voltage V_{OUT} at half the input voltage V_{IN} .

What are the uses for a **rail splitter circuit**?

Measuring a bipolar voltage

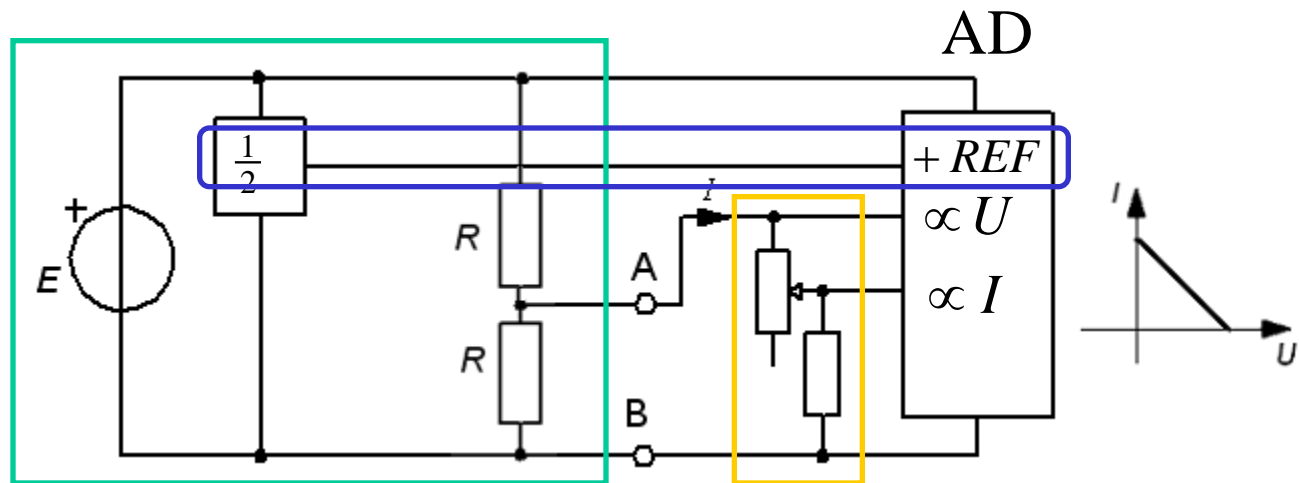


```
signed long Advalue;  
Advalue = ADRESH*256;  
Advalue += ADRESL;  
Advalue -= 512; // -512...0...+512
```

If an alternating voltage is referred to $E/2$, the voltage can be measured with \pm sign.

AD with external reference?

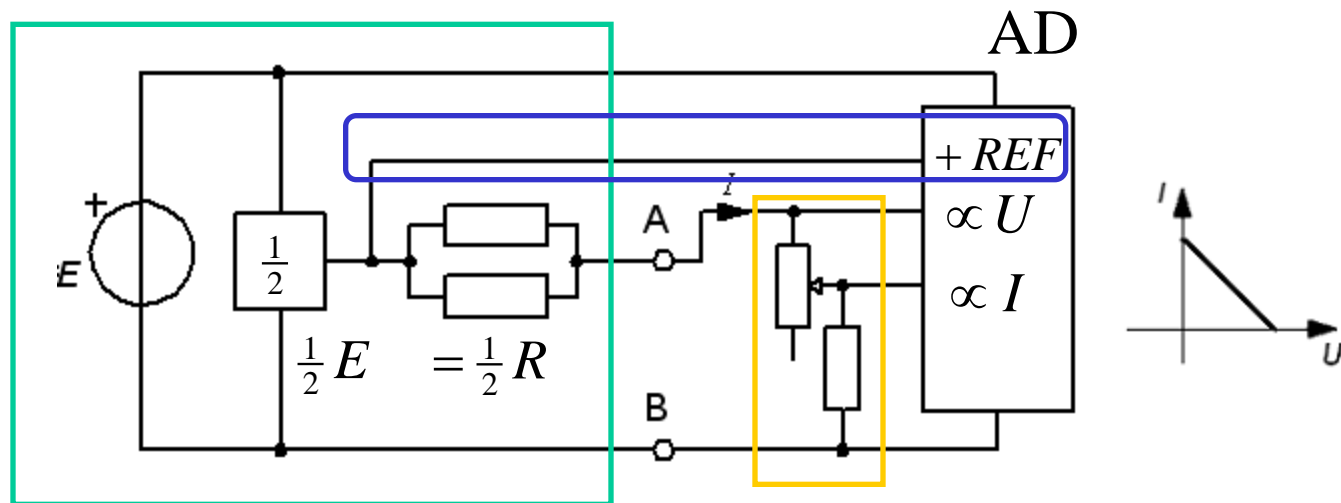
$U < 2,5$ V then $REF=2,5$ V is a better choice than $REF=5$ V.



- If the AD-converter uses 2,5V reference (from the rail splitter circuit) we will get **better measuring accuracy!**

AD with external reference?

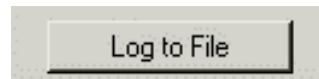
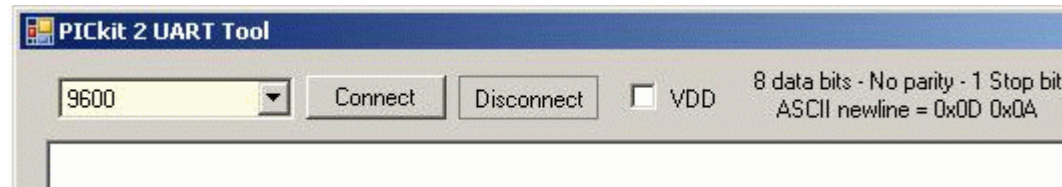
$U < 2,5$ V then REF=2,5V is a better choice than REF=5V.



- If the AD-converter uses 2,5V reference (from the rail splitter circuit) we will get **better measuring accuracy!**

Log measurement values to a text file

Use PICKit2 UART tool for logging measurements in the file.



Start/Stop
log to file



data.txt

Measured values to Excel



data.txt

Textimportguiden - Steg 1 av 3

Textguiden har fastställt att dina data är avgränsade. Välj Nästa om detta är korrekt eller Avbryt om inte.

Ursprunglig datatyp

Välj den typ som bäst passar filens innehåll.

Avgränsade fält - Semikolon, Komma, Tabulator, etc.

Med fast bredd - Fältens bredd är konstant.

Börja importera från rader 1 till 5 i kolumn 1 till 2.

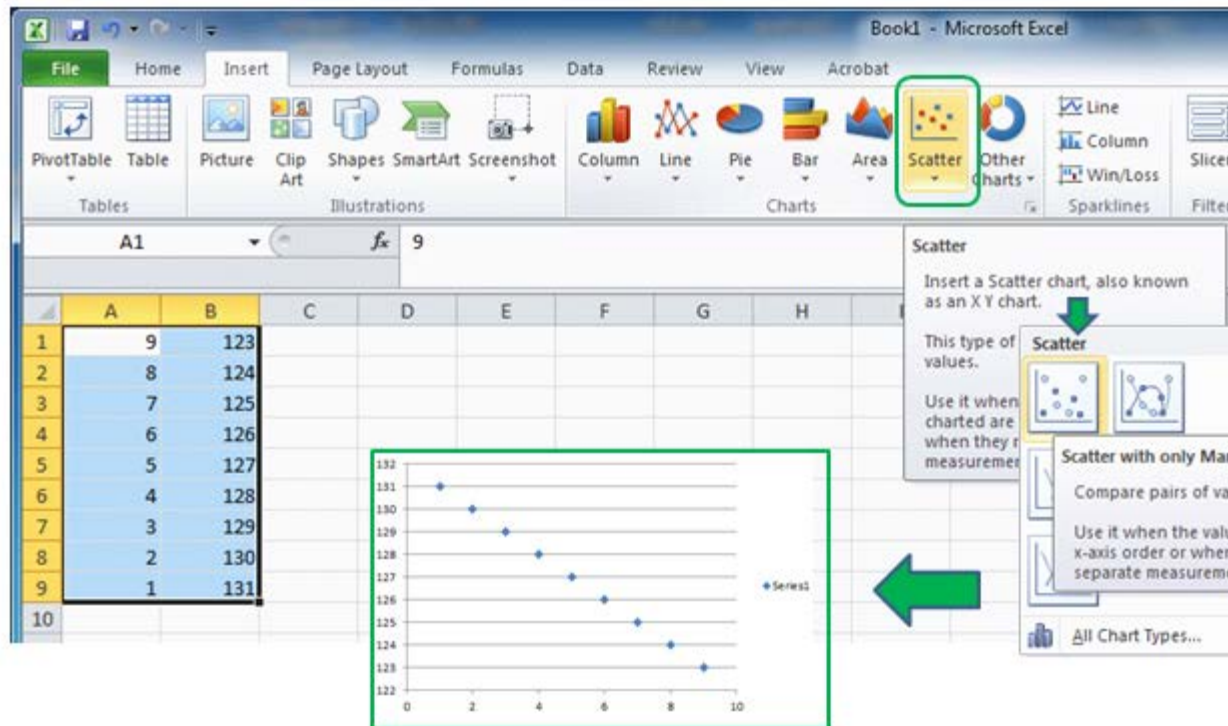
Förhandsgranskning av fil C:\Documents and Settings\William Sandqvist\My Documents\data.txt

1	000
2	000
3	023
4	024
5	025

Avbryt < Bakåt Nästa > Slutför

Open file **data.txt** in Excel. The file's tab-separated format is suitable for direct import with the wizard.

Scatter plot in Excel



Mark *data-columns* and then click on **Scatter** in the **Insert**-menu.

Trendline and Equation

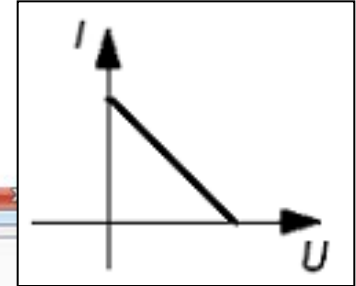


Chart Tools

Design Layout Format

Gridlines Plot Area Chart Wall Chart Floor 3-D Rotation Trendline

- None: Removes the selected Trendline or all Trendlines if none are selected
- Linear Trendline: Adds/sets a Linear Trendline for the selected chart series
- Exponential Trendline: Adds/sets an Exponential Trendline for the selected chart series
- Linear Forecast Trendline: Adds/sets a Linear Trendline with 2 period forecast for the selected chart series
- Two Period Moving Average: Adds/sets a 2 Period Moving Average Trendline for the selected chart series

More Trendline Options...

Format Trendline

Trendline Options

Line Color

Line Style

Shadow

Glow and Soft Edges

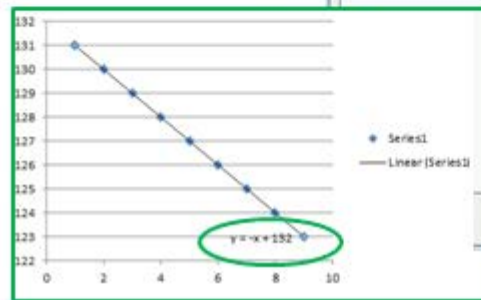
Trendline Options

Trend/Regression Type

- Exponential
- Linear**
- Logarithmic

**Layout – Trendline – Moore
Trendline Options**

Display Equation on Chart



Forward: 0,0 periods

Backward: 0,0 periods

Set Intercept = 0,0

- Display Equation on chart
- Display R-squared value on chart

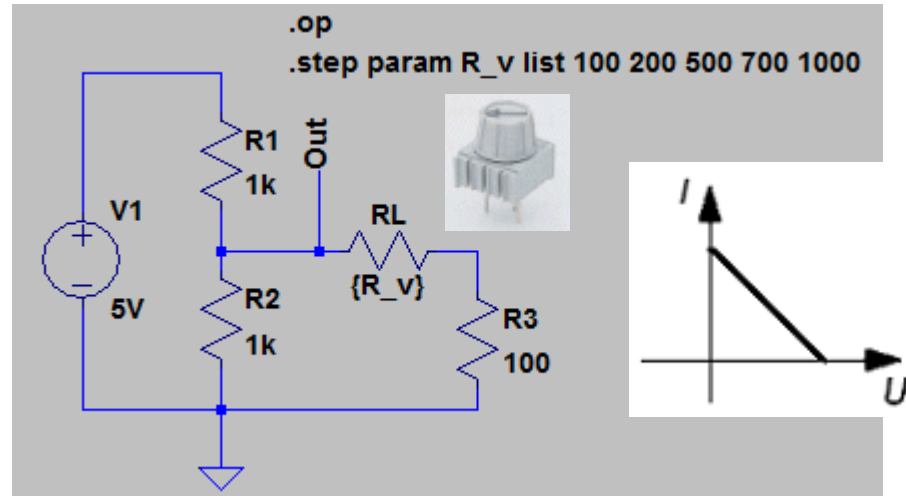
Close

Two-terminal equivalents proved?

If it is identical equations for the two equivalents - surely two-terminal equivalents are probable, although not proven?

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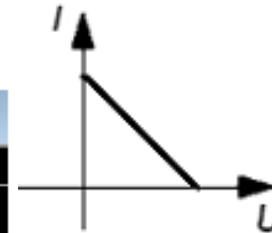
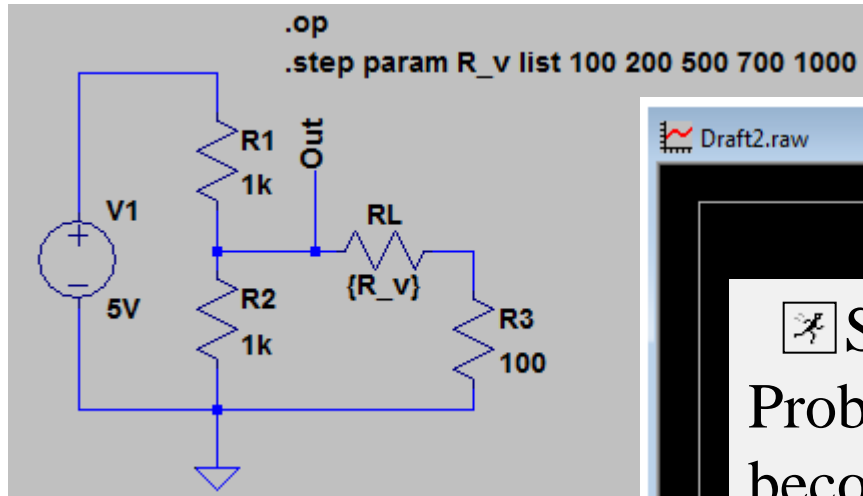
Simulate



We want to automatically simulate with different values of **RL**, eg. 100 200 500 700 1000 Ω .

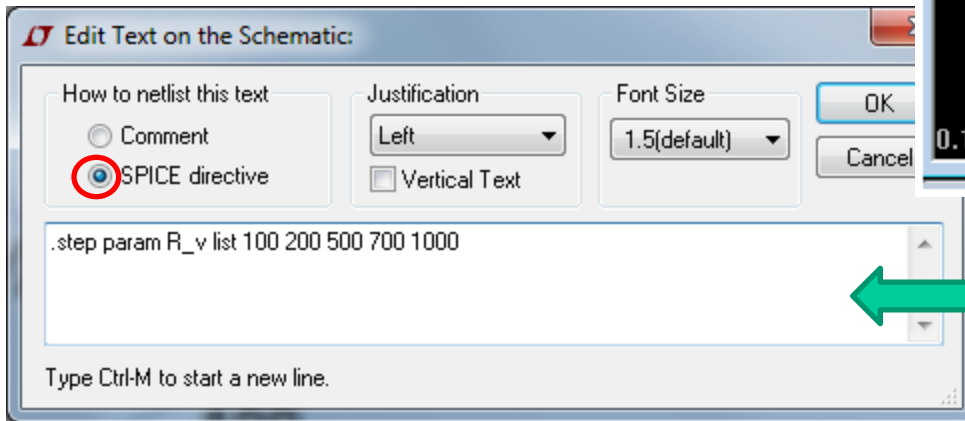
RL *value* must be changed to a parameter **{R_v}**. The curly brackets around the variable name **R_v** means just parameter.

Simulate



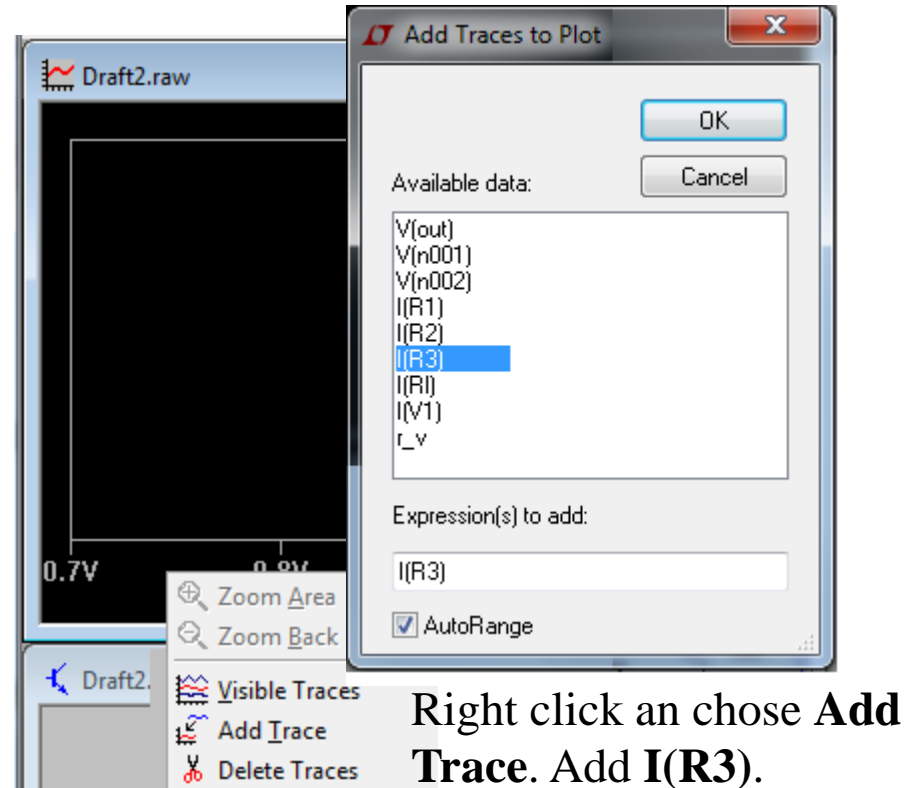
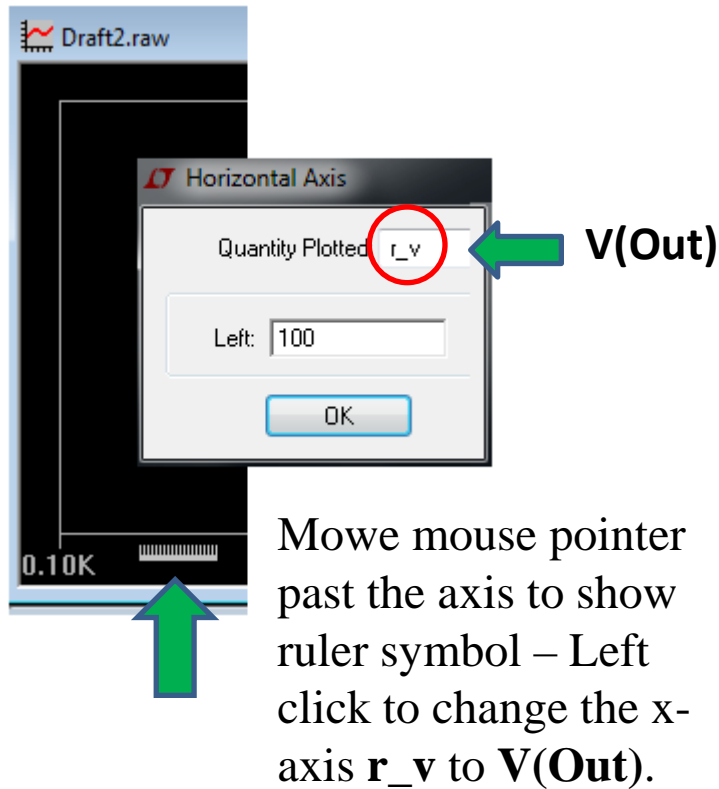
 Simulate.

Problem with plot: X-axis becomes the parameter **R_v**, we want **V(Out)**.

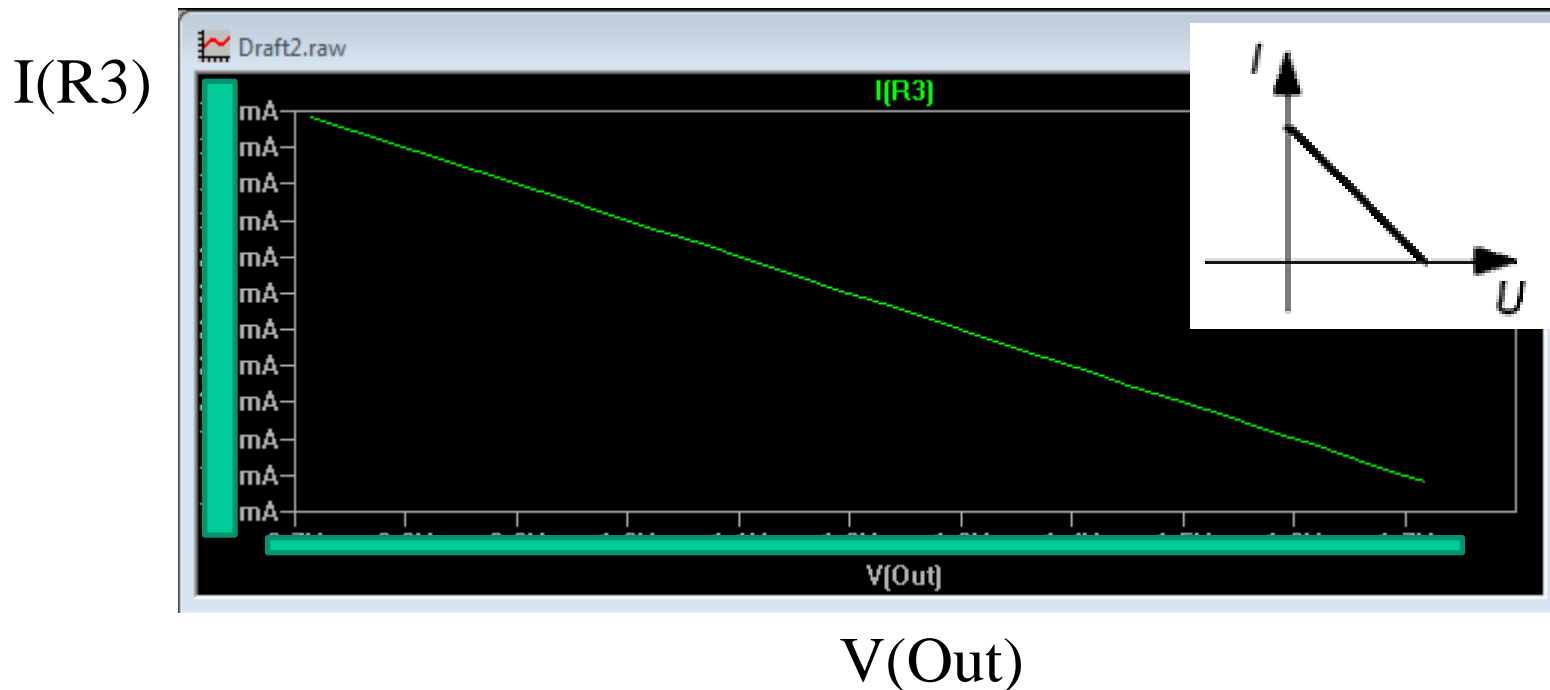


Edit Text, to insert SPICE directive in schematic.

Correct quantities in the plot



The circuit with simulated load



No mA or Volts are shown – you have to make your own calculations on this circuit later ...

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