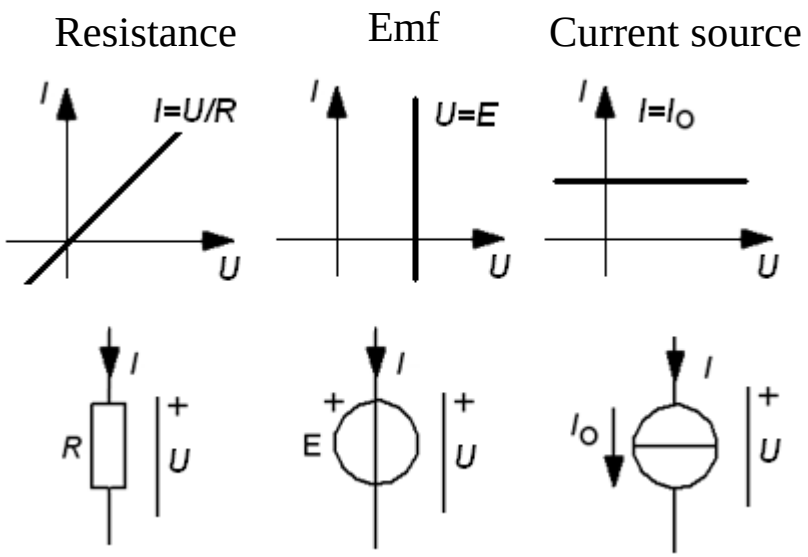
Circuit elements in graphical form



With this polarity definitions the elements receive power when the *U* and *I* are positive.
(Emf and Current generator are beeing ”charged”)

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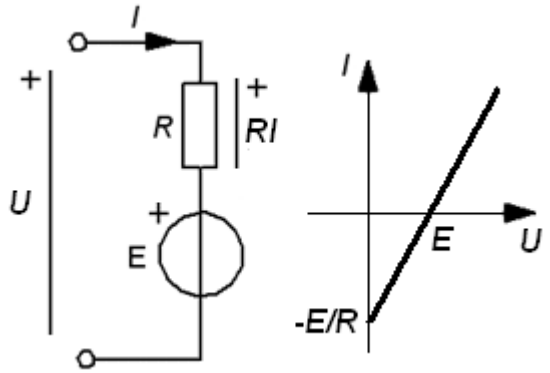
Two-terminal circuit with emf and resistance



$U = E + R \cdot I$ 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.

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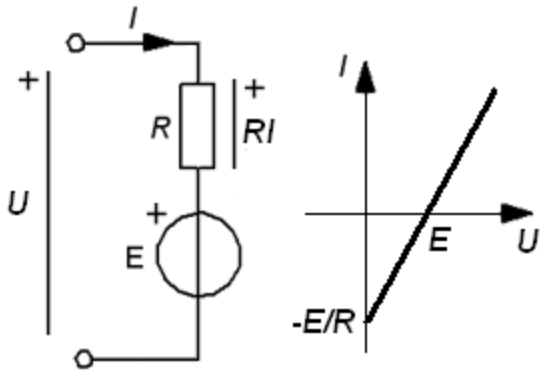
Two-terminal circuit with emf and resistance



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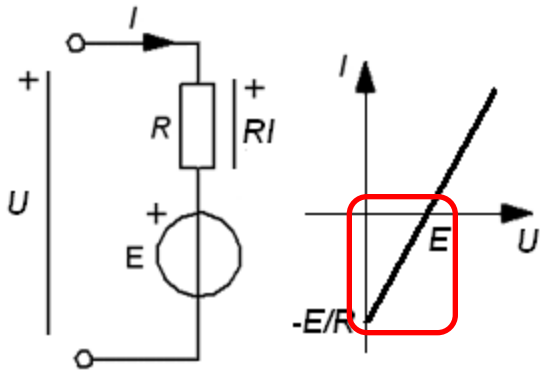
Two-terminal circuit with emf and resistance



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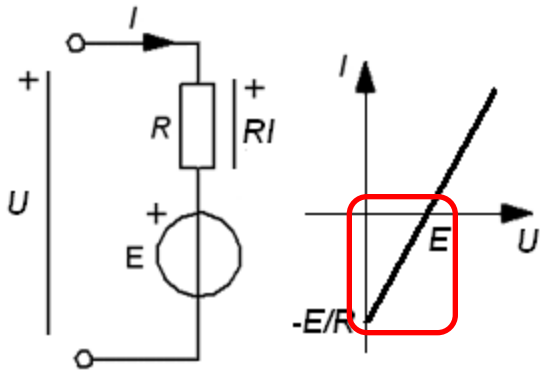
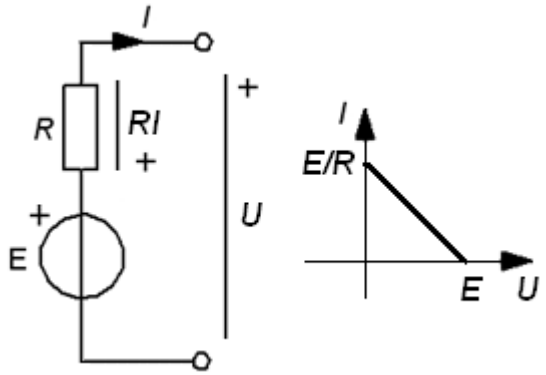
Two-terminal circuit with emf and resistance





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

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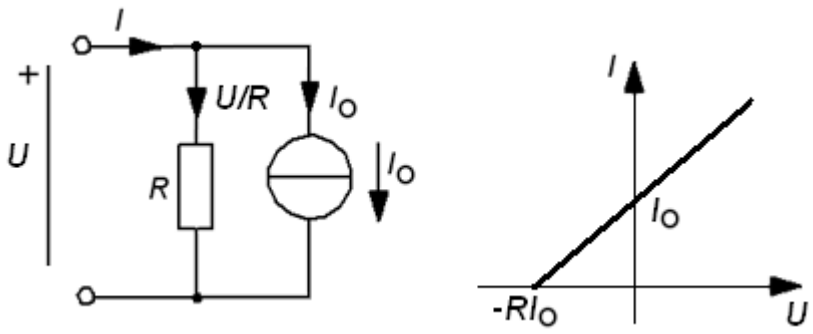
(Current source and resistance)



$I = U/R + I_0$

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

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

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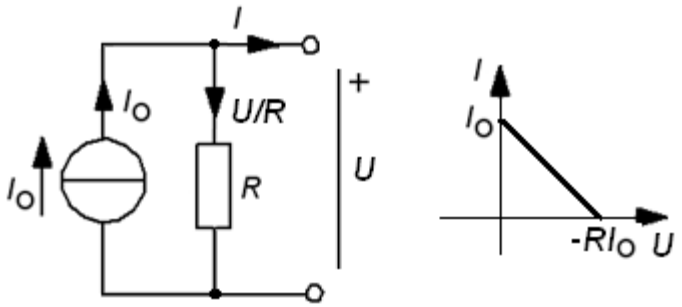
(Current source and resistance)



The circuit is delivering power.
Then it is convenient to define the current in the opposite direction.

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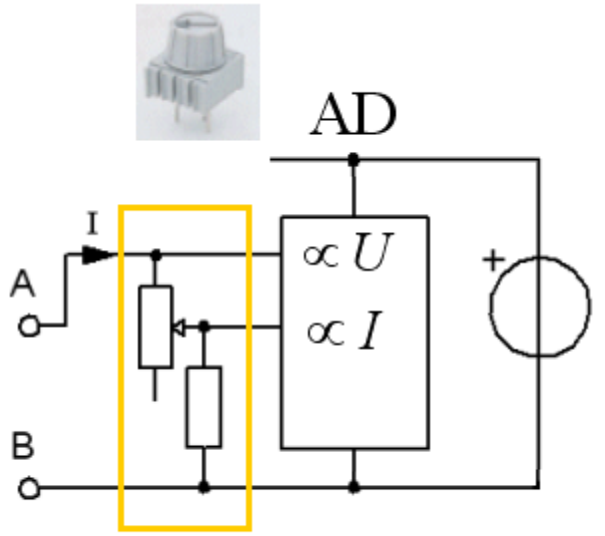
Measurements at the AD-Lab

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

Measuring equipment



Variable resistor load

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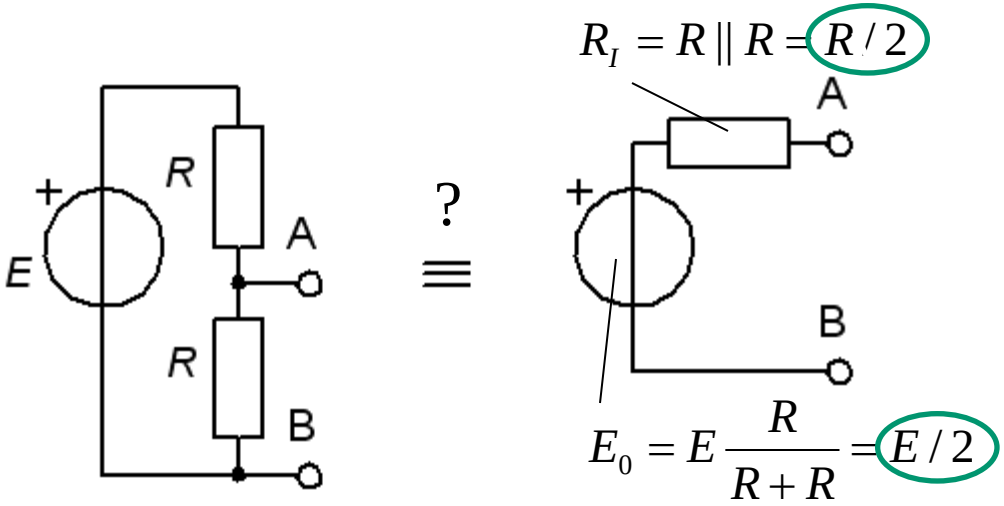
Are 2-terminal equivalents true?

Thevenin theorem says:



Is this correct?

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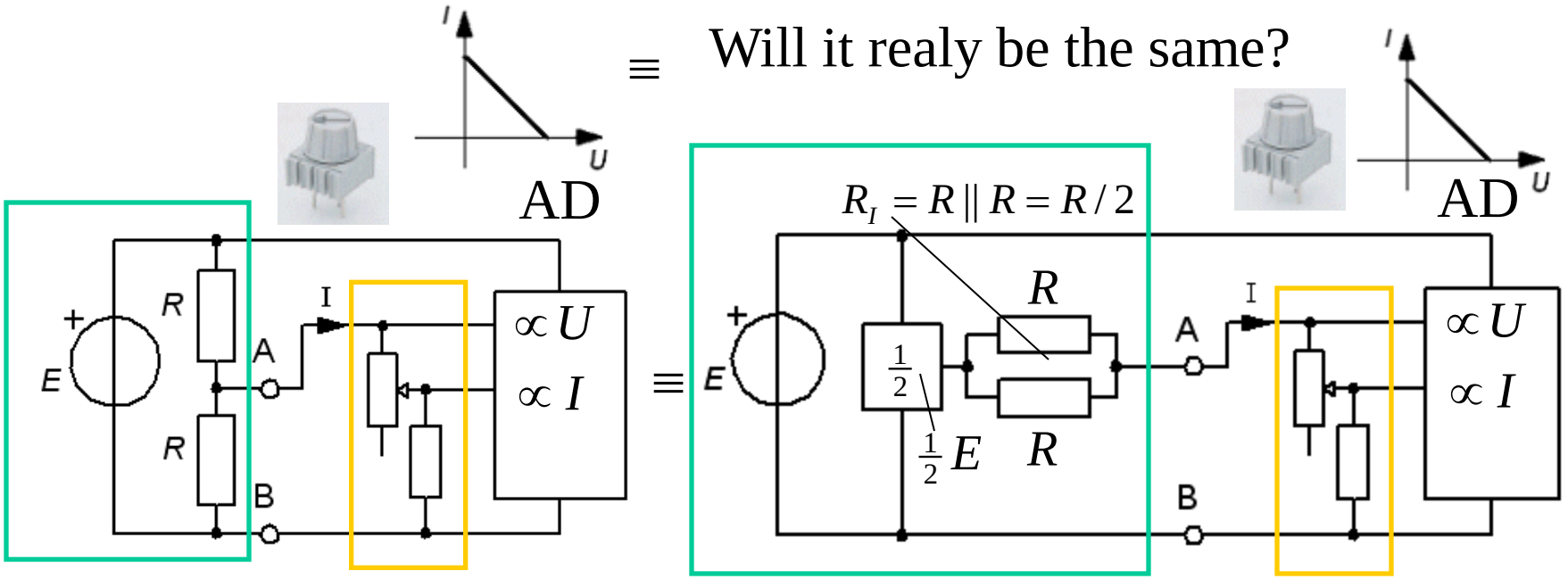
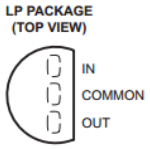
Measurements on two-terminal circuits



Variable resistor load



TLE2426

Rail splitter virtual ground

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

Variable resistor load

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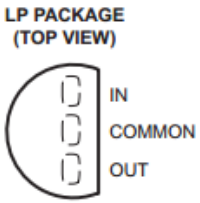
Rail splitter virtual ground?

TLE2426



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

This circuit containes 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**?

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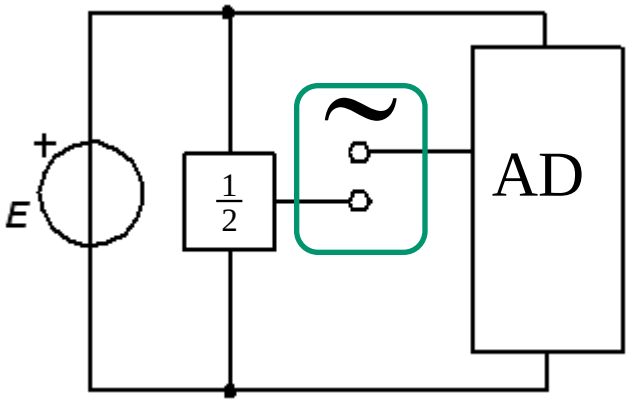
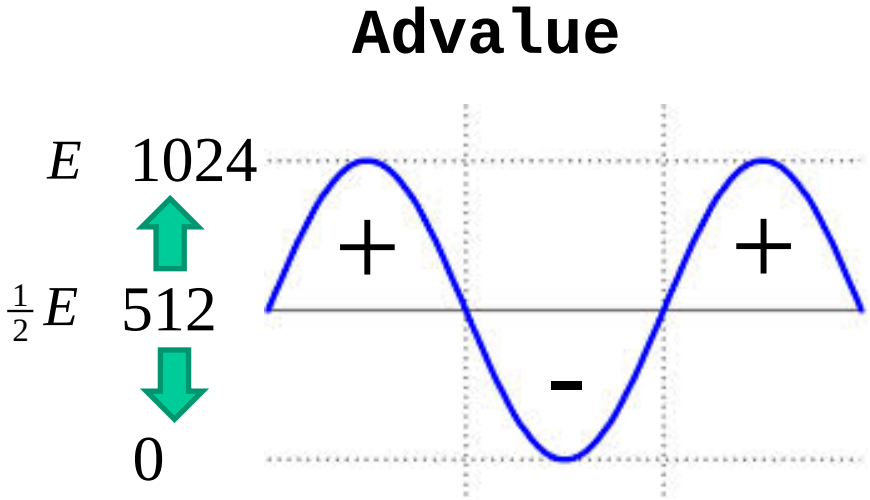
Measuring a bipolar voltage





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

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

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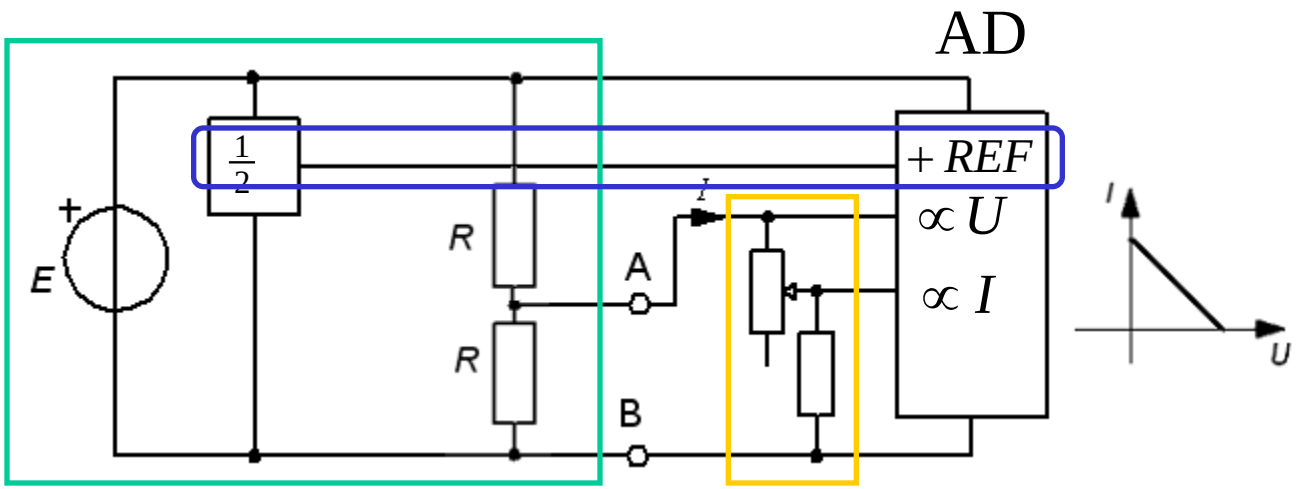
AD with external reference?

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**!

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AD with external reference?

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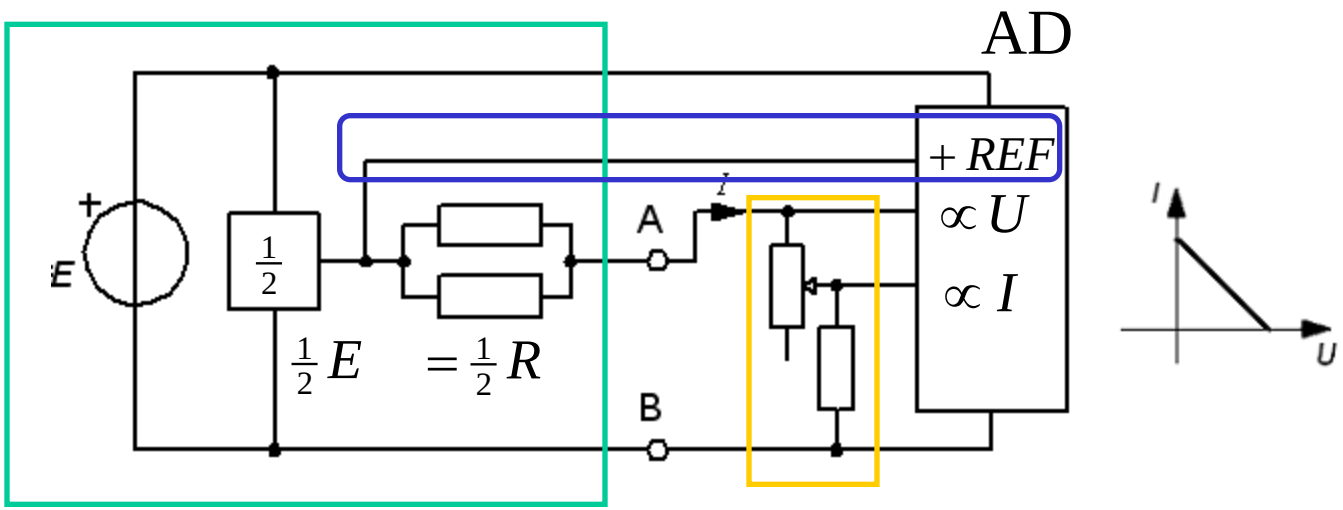
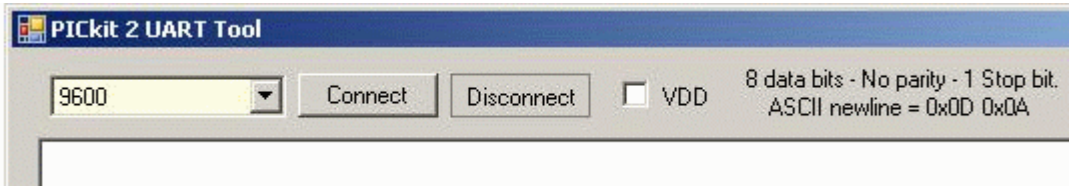
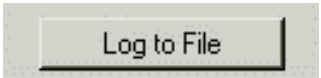


• If the AD-converter uses 2,5V reference (from the rail splitter circuit) we will get **better measuring accuracy**!

Log measurement values to a text file

Use PICKit2 UART tool for logging measurements in the file.





Start/Stop log to file

`data.txt`

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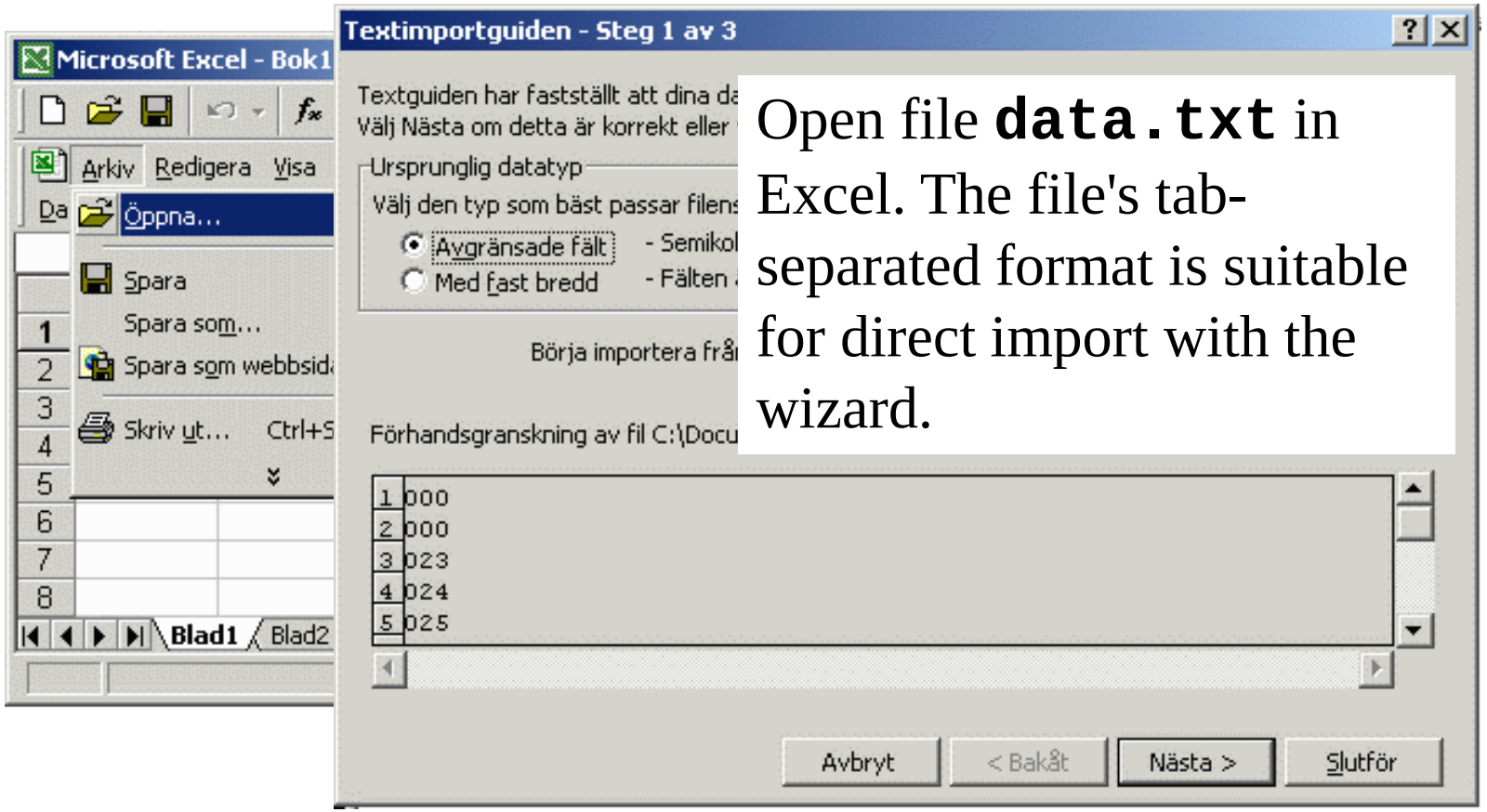
Measured values to Excel

`data.txt`



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

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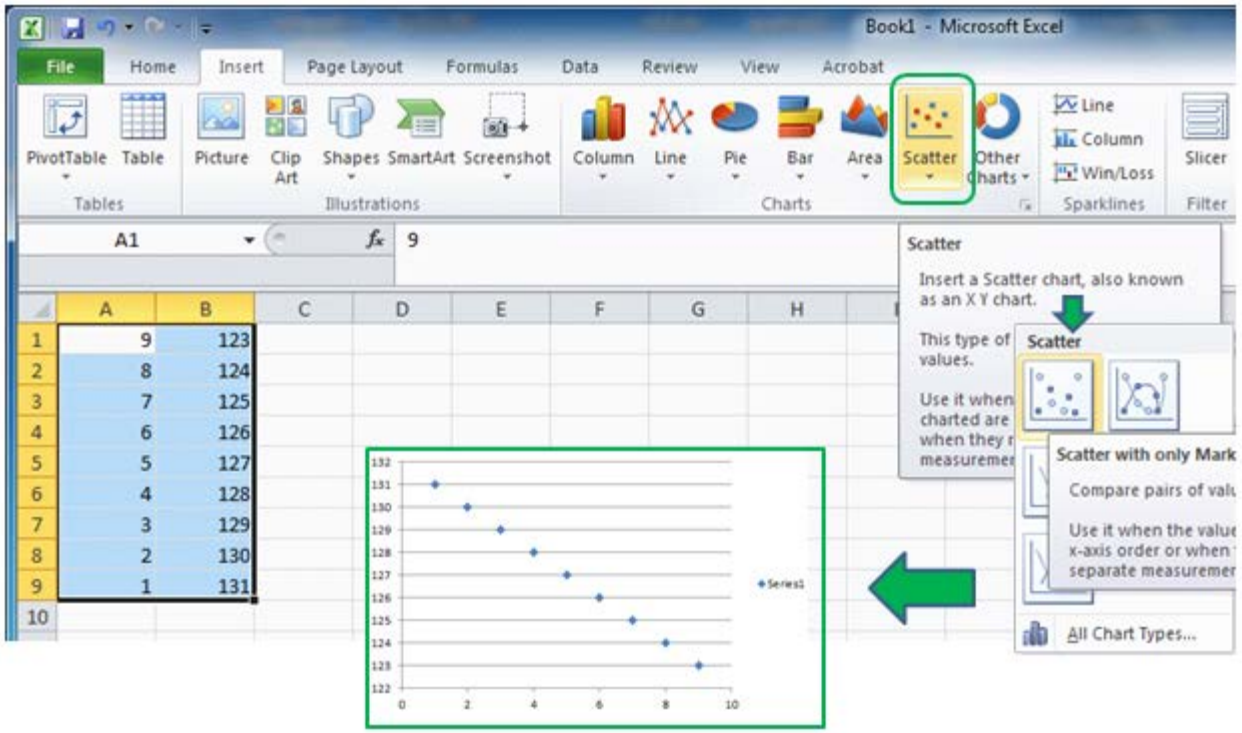
Scatter plot in Excel



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

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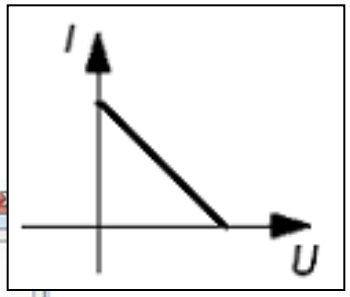
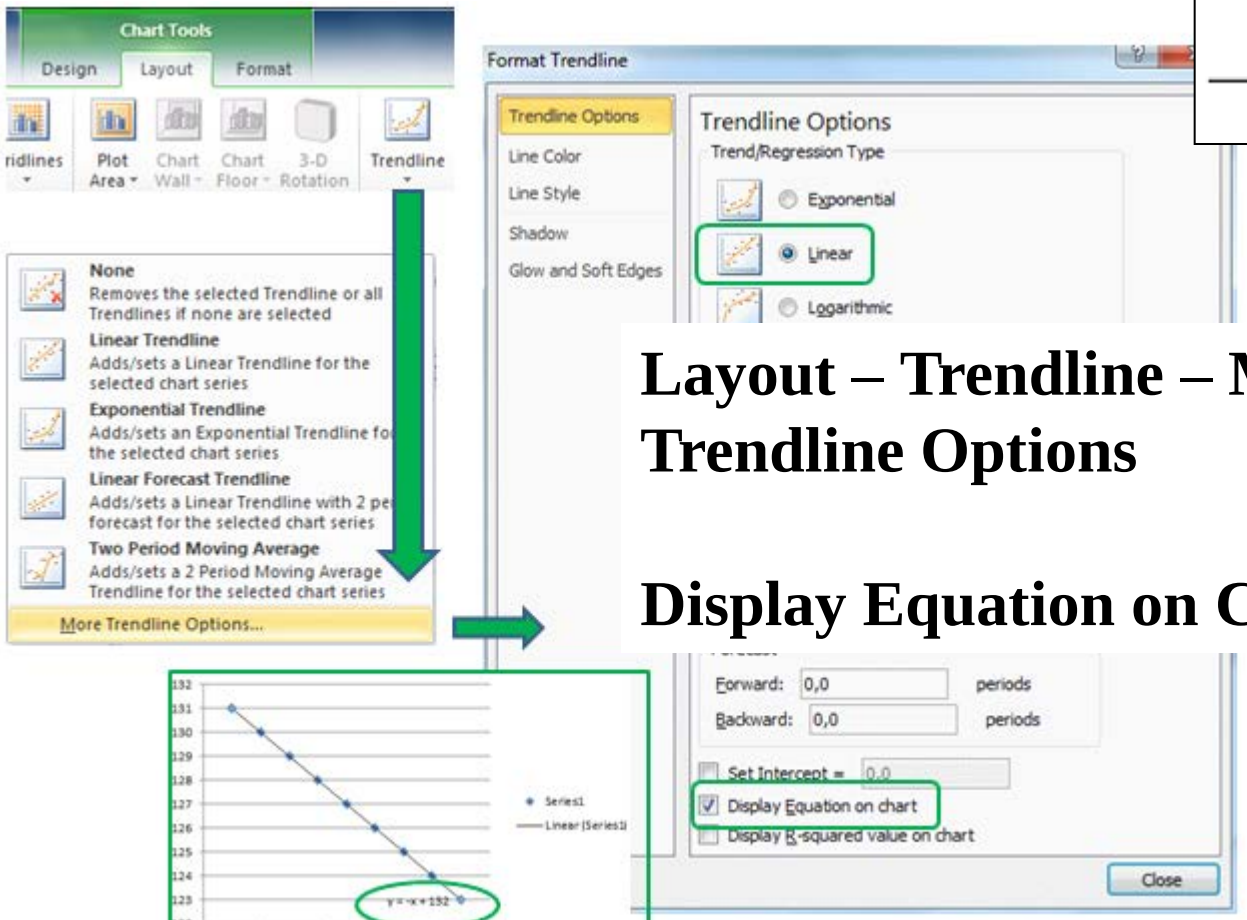
Trendline and Equation





Layout – Trendline – Moore Trendline Options

Display Equation on Chart

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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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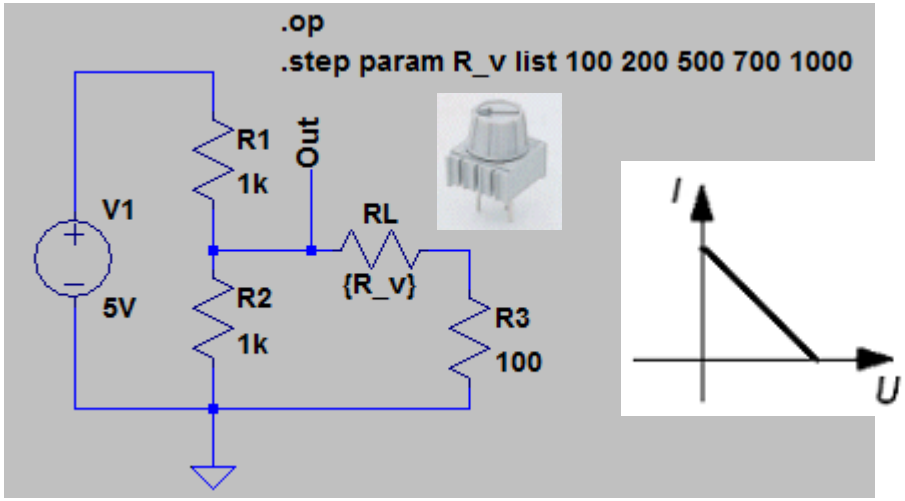
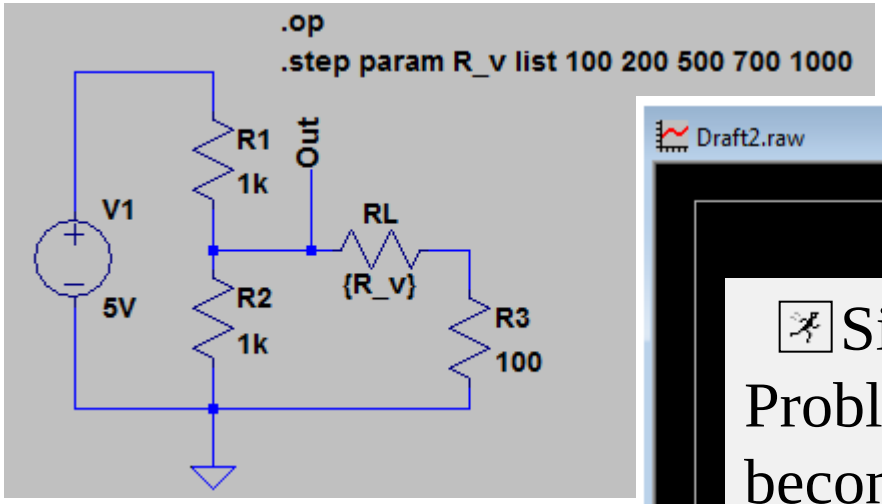
Simulate

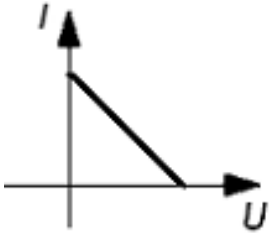


We want to automatically simulate with different values of **RL**, eg. 100 200 500 700 1000 Ω.

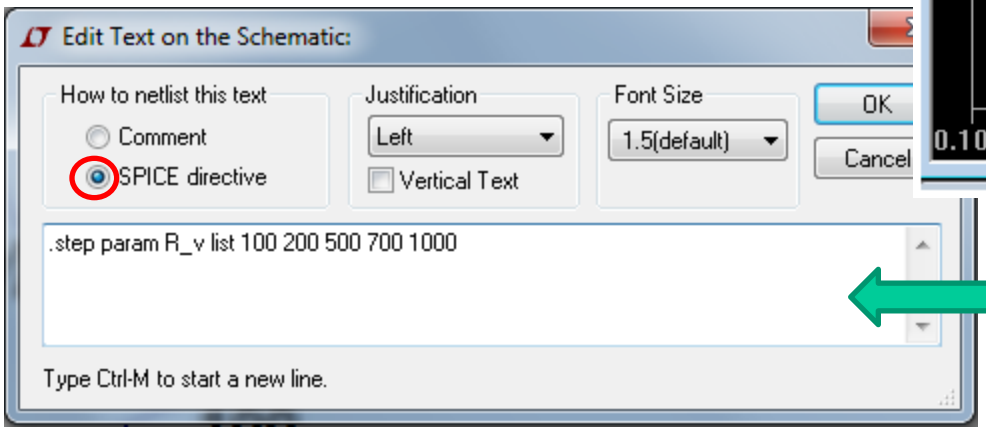
RL *value* must be changed to a parameter **{R_v}**. The curly brackets around the variable name R_v means just parameter.

Simulate





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



Edit Text, to insert SPICE directive in schematic.

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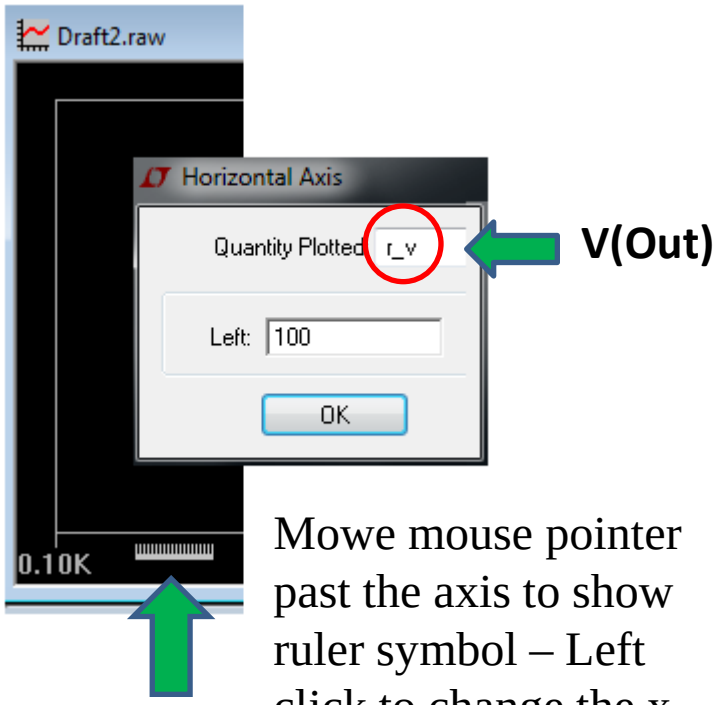
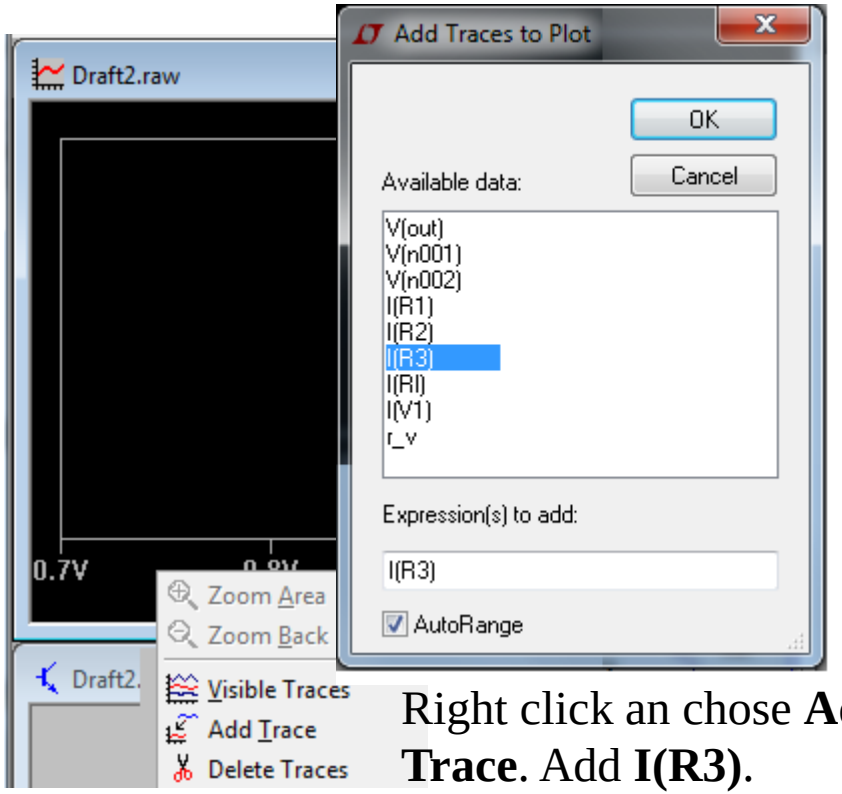
Correct quantities in the plot



V(Out)

Mowe mouse pointer past the axis to show ruler symbol – Left click to change the x-axis **r_v** to **V(Out)**.



Right click an chose **Add Trace**. Add **I(R3)**.

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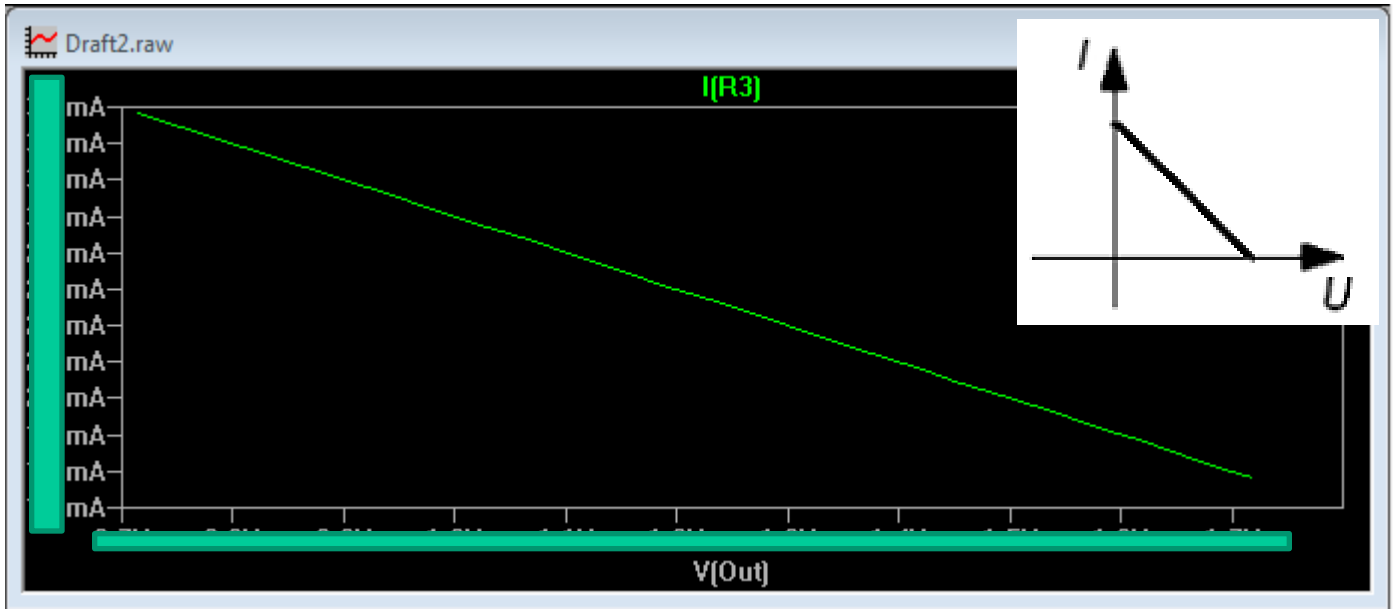
The circuit with simulated load

I(R3)



V(Out)

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

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