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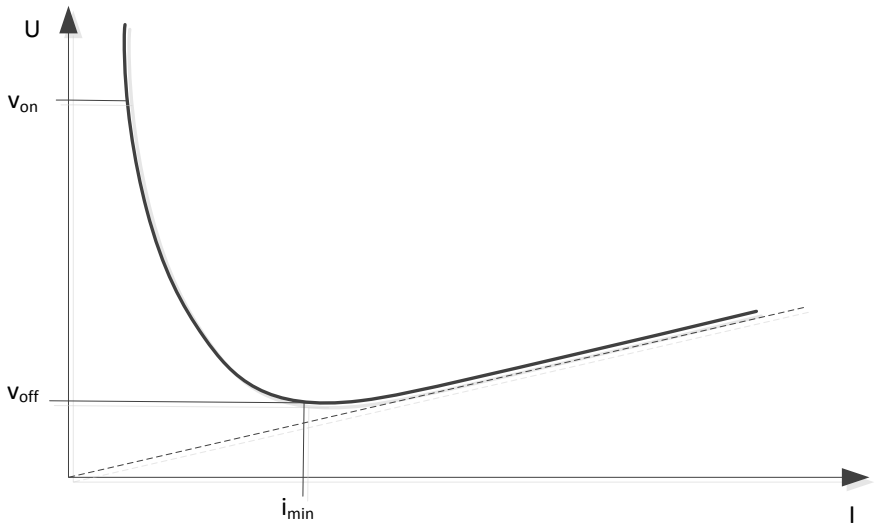
Exercise 12: Modelling Electric Arc Discharges

In this exercise, we want to create the electric component model for the discharge through a light arc. We want to use an idealized light-arc model for this purpose and model the behavior using discrete events.

The characteristic curve of a light arc is quite complex and the parameters are hard to retrieve for realistic models. However, the basic behavior is roughly captured by the following U-I diagram.



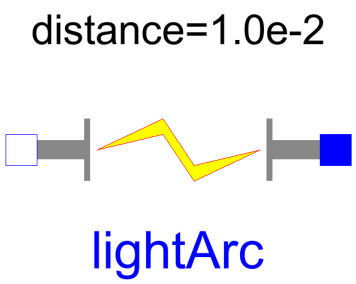
For the ignition of a light arc, a high voltage is needed. This “dielectric strength” is typically 25kV per cm of air gap. Once the arc has ignited, a plasma basically creates a short circuit between the two contacts. The resistance decays with increasing current and the characteristic curve has a hyperbolic regime which prescribes the minimum power needed to sustain the arc (U*I = const). For higher currents the characteristic curve resembles the one of an Ohmic resistor.

When the ignition voltage is supplied by a capacitor, the instable hyperbolic regime can be expected to be traversed instantly. Voltage and current will then establish their equilibrium on the Ohmic part of the curve. For our simplified model, we will neglect the hyperbolic part and assume that the arc is extinguished, if the voltage drops below a threshold of 5kV/cm. The minimal voltage will occur at a minimal current of 1 A.

Hence we presume the following idealizations:

- When not ignited, the current is zero.
- The arc ignites at a field strength of 25kV/cm.
- When ignited, the arc behaves as a Ohmic resistor.
- When the voltage sinks below the minimal voltage, the arc is extinguished.

Model this behavior in an electric component. Inherit your component from Modelica.Electrical.Analog.Interfaces.OnePort:



Test your light arc component in the following circuit where the capacitor is constantly loaded from a current source.