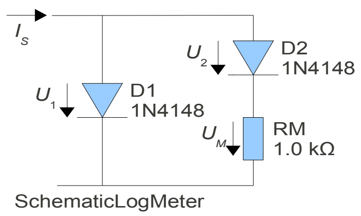
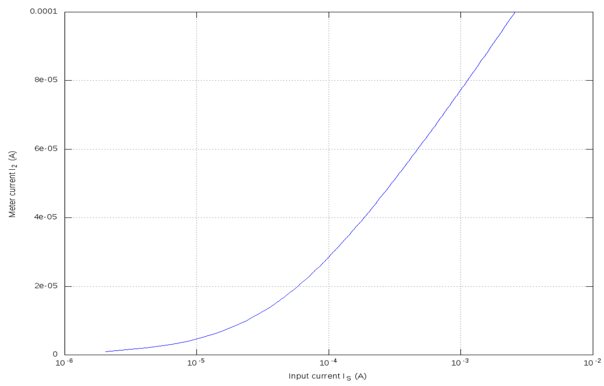
Log meter

The logarithmic meter circuit presented below was developed to achieve a good level indication on a pseudo-logarithmic deflection of the meter needle.





Pseudo-logarithmic meter where the current through the meter resistor is determined by the ratio between the currents through the diodes. The relation between input current and meter current is shown to the right and becomes logarithmic for meter currents above approximately 20 µA.

The input current I_S is divided between the two branches as the currents I_1 through diode D1 and I_2 through diode D2 and the meter resistance R_M. The voltage at the input is the forward voltage for diode D1 due to the current I_1 and this must equate the voltage across diode D2 due to the current I_2 plus the voltage across the meter resistor.

$$\eta U_T \ln\left(\frac{I_1}{I_0}\right) = \eta U_T \ln\left(\frac{I_2}{I_0}\right) + R_M I_2$$

Assembling the logarithmic expressions on the left side enables removal of I_0 and using the exponential function the current through D1 becomes expressed by the current through D2.

$$\ln\left(\frac{I_1}{I_2}\right) = \frac{R_M I_2}{\eta U_T} \quad \Rightarrow \quad I_1 = I_2 \exp\left(\frac{R_M I_2}{\eta U_T}\right)$$

The relation between input current and meter current becomes:

$$I_S = I_1 + I_2 = \left[1 + \exp\left(\frac{R_M I_2}{\eta U_T}\right)\right] I_2$$

The response is plotted above and approximates a logarithmic relation for meter currents above some 20 µA corresponding to 20 mV across the meter coil. The ratio between the diode currents is a factor of two at this level so the response becomes approximately linear for lower current.

References

1 Lennart Råde and Bertil Westergreen “Mathematics Handbook for Science and Engineering”, Studentlitteratur, 5th edition, 2004.