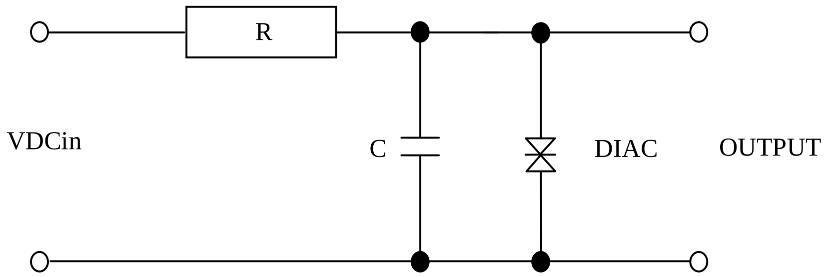
A D I A C OSCILLATOR

By Luiz Amaral
PY1LL/AC2BR

A DIAC is a two terminal electronic device that conducts in both directions since its voltage exceeds a minimum value **Vm**. As this value is reached, the DIAC conducts keeping on its terminals a voltage smaller than **Vm**, that is, it has a negative resistance characteristic. So it can oscillate and amplify power.

A simple diagram of an oscillator with DIAC is shown in the figure below.



The input voltage must be DC, but with any polarity, only respecting the capacitor polarity if any.

For a DB3 DIAC, **VDCin** is 34V and resistors from 1K to 100K and capacitors from 1n to 1u were tested with success.

The output wave shape has a rising exponential with time constant **RC** and a quick falling due the DIAC conduction that discharges the capacitor and the cycle repeats.

Let's analyze the circuit with:

VDCin = input DC voltage

Vd = DIAC trigger voltage

Vmin = DIAC cutoff voltage after a conduction (always smaller than **Vd**)

T = output period = **1/F** = inverse of the output frequency

V = time dependent output voltage

We have:

$$V = (Vd - Vmin) \cdot e^{(-t/RC)} / [e^{(-T/RC)} - 1] + [Vmin \cdot e^{(-T/RC)} - Vd] / [e^{(-T/RC)} - 1] \quad [1]$$

As the output voltage would tend to **VDCin**, when time tended to infinity with no trigger, we get the frequency making $\mathbf{t \rightarrow \infty}$ in **[1]**:

F = 1 / {R . C . ln[(VDCin – Vmin) / (VDCin – Vd)]}   [2], where **ln** is the natural logarithm function.

We see clearly that **VDCin** has to be greater than **Vd**, because, if they are equal, the frequency will be zero, that is, no oscillation will occur.

Expression **[2]** is an approximate one because we are not considering the capacitor's discharge time that, although small, is finite. So the expression is more exact when one makes greater **R** and smaller **C** in the product **RC**, as the discharge time decreases and the precision increases.