A DIAC OSCILLATOR

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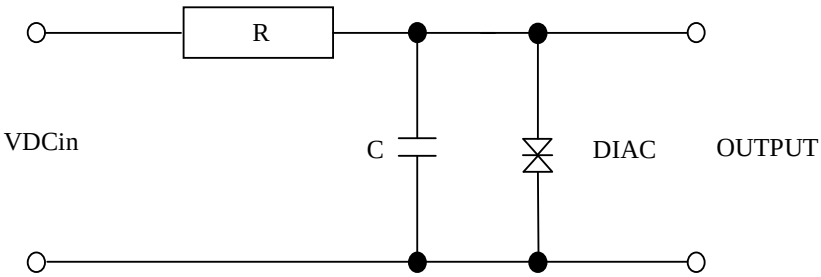
A DIAC is a two terminal electronic device that conducts in both directions since the voltage surpasses a minimum value Vm. When that value is reached, the DIAC conducts keeping on its terminals a voltage smaller than the triggering one, that is, it presents a negative resistance characteristic. So, it is able to oscillate and amplify (power).

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



The input voltage must be DC, may have any polarity, only considering the capacitor polarity, if it exists.

For a DIAC type DB3, VDCin minimum is 34V and resistors from 1 to 100K and capacitors from 1n to 1µ where tried with success.

The output wave shape has an exponential front-end with time constant RC with a quick fall due the DIAC conduction, that discharges the capacitor and the cycle repeats.

Analyzing the circuit with:

VDCin = input DC voltage

Vd = DIAC triggering voltage

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

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

V = time dependent output voltage

We have:

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

As, if we didn't have triggering, the output voltage tended to VDCin, when the time tends to infinity, making $t \rightarrow \infty$ in [1], we have the frequency value:

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

We see that VDCin must be higher than Vd, as if they are equal, the frequency tends to zero, that is, we don't have any oscillation.

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

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