Symmetric multivibrator using two inverting gates

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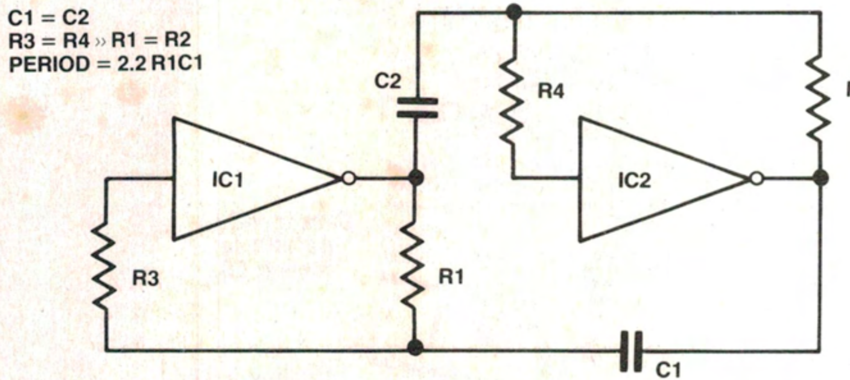

THIS CIRCUIT provides a frequency fairly independent of supply voltage, the output having a near-perfect 1:1 duty cycle. It is based on the improved astable multivibrator circuit described in *ETI Circuit Techniques Volume 1*, p.68, and is useful when low power consumption and simplicity are the main considerations.

The circuit uses the dual RC relaxation circuits formed by R1C1 and R2C2, and is self-starting as it has no stable steady-state. While astable multivibrators using a single RC relaxation circuit suffer non-unity space-to-mark ratio due to the transfer voltage not being exactly halfway between the supply voltages, this circuit avoids the problem by using a dual relaxation circuit based on *two inverter sections on the same IC chip.*

The voltages applied to the gates of both inverters relax exponentially until one of them reaches its gate's transfer voltage. Hence the states of the inverters change instantaneously and the cycle repeats with the two inverters swapping their roles.

Resistors R3 and R4 should have a value of more than three times that of R1 and R2 for the RC relaxation circuits to behave as if R3 and R4 were infinite. However, too high values of R3 and R4 may affect the operation of the circuit as the voltages at the inputs of the inverters may then fail to follow the relaxation voltages. The only requirements for proper operation are that IC1 and IC2 must be sections of the same physical integrated circuit chip, and that corresponding components of the dual circuits must have the same nominal values.

In my particular application, I used a 4009 CMOS hex-inverter chip with R1 = R2 = 300k (20% tolerance), R3 = R4 = 1M (20% tolerance), C1 = C2 = 680p (10% tolerance) of the same production batches. The frequency obtained is fairly stable (with only 33% variation when the supply voltage varies between 3.3 V and 15 V) and its duty cycle is almost a perfect 1:1 over the whole permissible range of supply voltage. When the ratio R3/R1 = R4/R2 is high, the period of the circuit should have the value of 2.2R1C1; in my application it is about 400 ns.