

When is a gate not a gate?

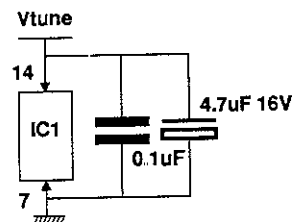
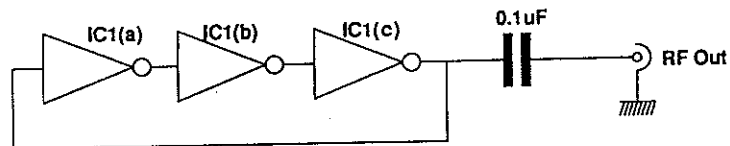
Ian Forster has found that AC logic gates can be used to form simple, cheap yet repeatable rf oscillators.

In a recent article in *Electronics World*¹ I showed how 74AC series logic gates could be used in power conversion and switching applications. This article makes use of another useful feature of this logic gate series – namely their fast response speed and low propagation delay – to implement a series of vhf oscillators ideal for the experimenter.

All the following circuits have been tried with dual-in-line parts from different manufacturers and have proved very reliable. Good vhf construction techniques need to be used, as, linearly biased, the gates act as high-gain high-frequency amplifiers.

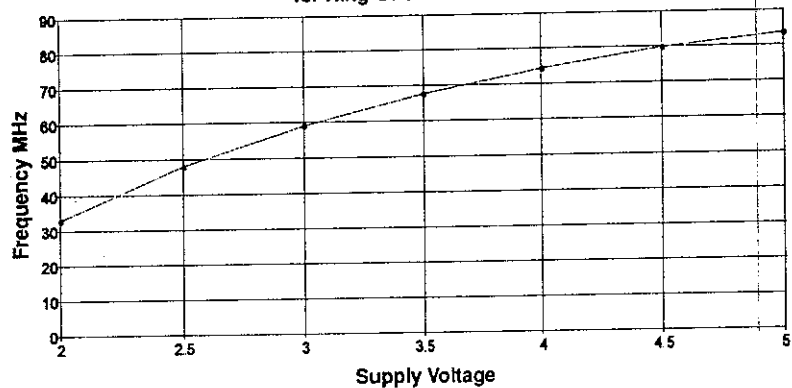
Most of the following circuits would not be well suited to battery powered applications. They tend to be current hungry. In addition, care must be taken when using multiple gates in one package not to exceed the maximum dissipation limits – 74AC gates are tough, but not indestructible.

Ring-of-three oscillator for high frequencies



AC gates can be used to produce a high-frequency equivalent of the standard 'ring-of-three' type oscillator. Again, operating frequency is controlled by varying the supply and hence the propagation delay of the gates. Power output is approximately 8.3dBm at 2V and +17dBm at 5V, with the third harmonic at -10dBc and the fifth at -16dBc, corresponding to +1.5dBm at 417.5MHz.

Voltage / Frequency Characteristic for Ring Of Three Oscillator

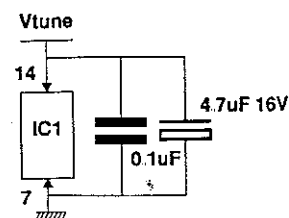
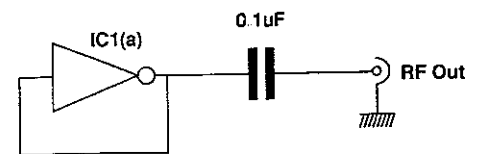
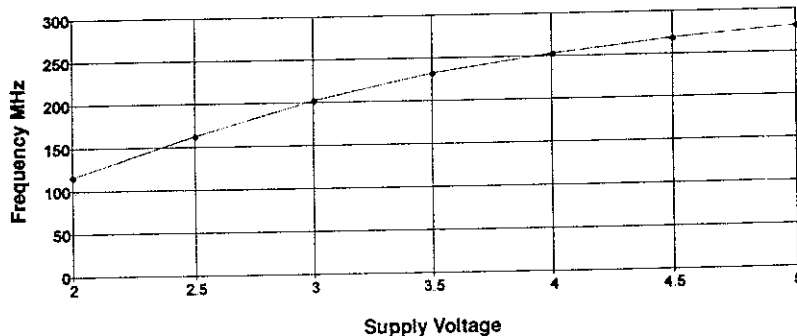


Oscillator for vhf

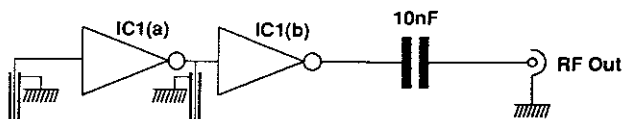
This is the simplest implementation of a vhf oscillator using a single inverter from a 74AC04. Oscillation occurs at the frequency at which the delay of the gate is equal to 180° phase shift. Output frequency is controlled by varying the supply, and hence varying

the propagation delay of the gate. Power output is approximately +6.5dBm at 2V and +16dBm at 5V, with the third harmonic at -16dBc (corresponding to -4dBm 840MHz at 5V)

Voltage / Frequency Characteristic for Single Gate Oscillator



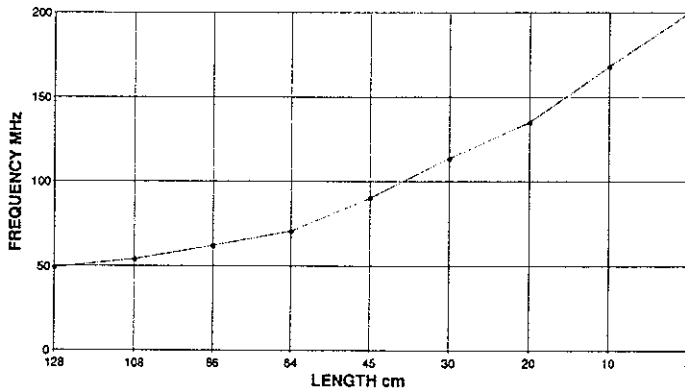
Oscillator uses coaxial cable



RG174U COAXIAL CABLE

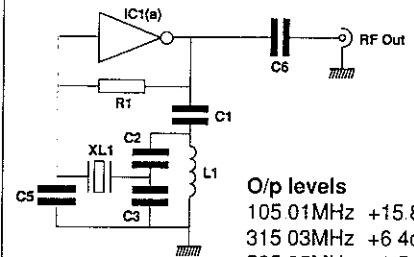
For a given supply voltage the oscillator here gives good performance as a fixed frequency source. Operating frequency is determined by a combination of the delay in the coaxial and the propagation delay of the gate. Using a 5V supply power output was constant at approximately +16dBm

RG174U LINE LENGTH AGAINST FREQUENCY



Crystal oscillator

This is a fifth-overtone crystal oscillator based on the 74AC04. It runs near series resonance and provides a stable output at high level rich in harmonics. Typically, this would be used to form the basis of a low power vhf/uhf transmitter or, with filtering, as a vhf/uhf local oscillator for a receiver. Addition of a varactor diode coupled via an appropriate capacitor, across C_3 , using a resistor to bias it allows a degree of tuning



O/p levels
 105.01MHz +15.8dBm
 315.03MHz +6.4dBm
 525.05MHz -1.5dBm

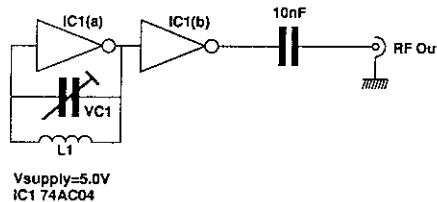
Vsupply 5V I=44mA
 Vsupply 3V I=22mA

- IC₁ 74AC04
- XL₁ 105MHz 5th overtone HC18U
- L₁ 135nH MC105 variable
- C₁ 5.6pF ceramic
- C_{2,3} 39pF ceramic
- C_{1,5} 22pF ceramic

LC oscillator

For a more compact oscillator the circuit is more suitable. This is a fairly standard LC type oscillator, with the output frequency being a function of the inductance, stray and wanted capacitance and gate delay. With L at 39nH and C at 1.5pF, measured noise was -90dBc/Hz at 10kHz offset with an associated +17dBm output

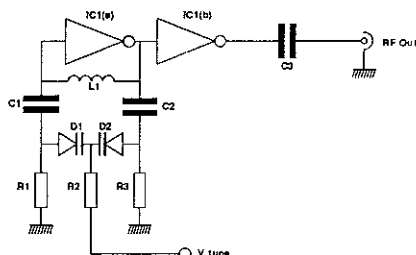
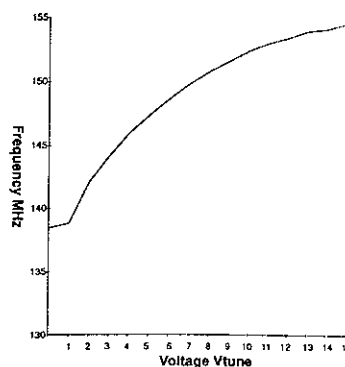
L ₁ (nH)	VC ₁ (pF)	o/p (MHz)
68	6	143.1
68	1.5	159.4
68	-	166.4
39	6	180.9
39	1.5	190.7
39	-	197.9



Vsupply=5.0V
 IC1 74AC04

Oscillator for 2m band

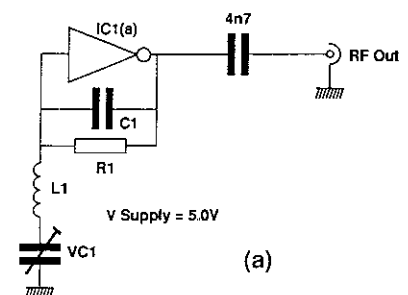
An LC voltage-controlled oscillator designed to cover the 2m amateur band can be formed from AC gates when used with a synthesiser IC such as the National Semiconductor LMX1501A. High output level of the oscillator makes it well suited to driving a level 17 double balanced diode mixer. This with a high intermodulation performance front-end amplifier such as the MAVII from Mini Circuits, could form a high immunity receiver front end for cluttered signal environments



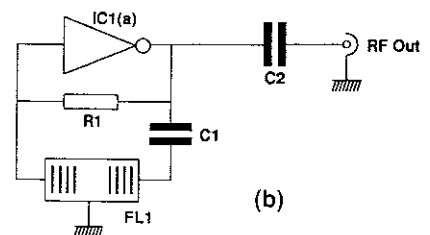
- L₁ 68nH 32CS smt
- IC₁ 74AC04
- R_{1,3} 18kΩ
- C_{1,2} 100pF ceramic
- C₃ 10nF ceramic
- D_{1,2} BB405B varactor

And at uhf

To complete this collection, (a) and (b) here show two oscillators designed to operate in the uhf band. In (a), C_1 provides feedback from output to input and, due to its low value, suppresses vhf oscillation, with R_1 biasing the gate into its linear mode. Inductor L_1 and the variable capacitor provide a variable phase shift to control the oscillator frequency. In (b), R_1 again places the gate in its linear mode but the feedback is a combination of C_1 and a 418MHz band surface-acoustic-wave resonator device, as used in key fob transmitters for car alarms.



(a)



(b)