ECL IC oscillates from 10 to 50 MHz

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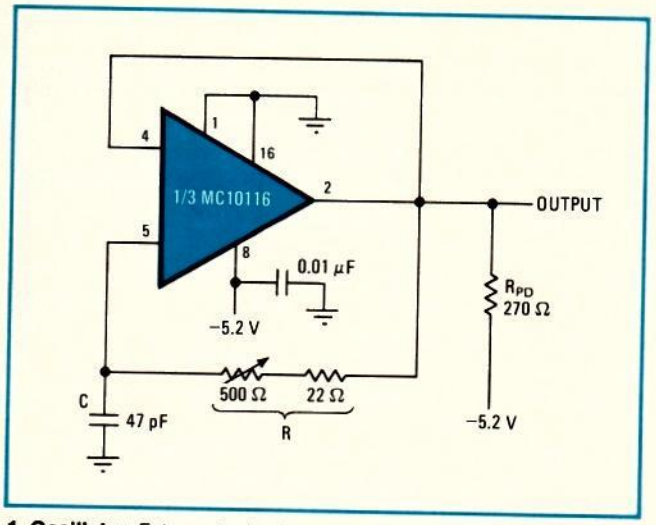
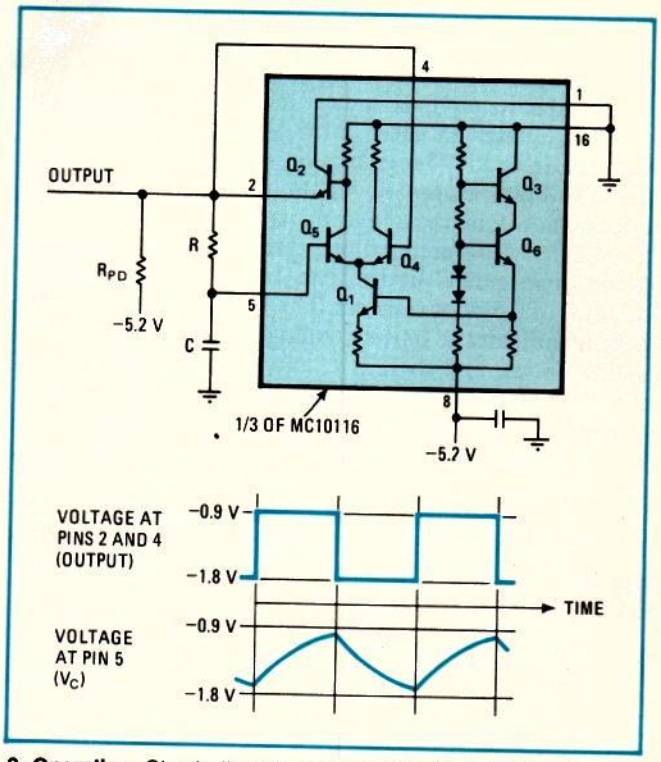
One of the simplest of oscillators, the emitter-coupled-logic type outlined in Fig. 1, uses one third of the circuitry of an MC10116 ECL integrated circuit. Besides the IC, the only elements required for the oscillator are resistor R and capacitor C. The frequency of oscillation equals 1/3.4 RC.

Details of the oscillator are shown in Fig. 2. Transistor Q_1 is a constant-current source for the differential amplifier made up of Q_4 and Q_5. The output signal, taken from emitter-follower Q_2 at pin 2, is fed back to Q_4 as the oscillator reference voltage at pin 4. Thus, pins 2 and 4 are always at the same voltage, and they switch between the ECL levels shown in the waveforms.

Operation of the circuit is indicated by the waveforms of voltage at pins 2 and 4, and at pin 5. The capacitor charges and discharges through resistor R when pins 2 and 4 go higher or lower than pin 5. When pins 2 and 4



1. Oscillator. Extremely simple connections to emitter-coupled-logic IC result in an oscillator that provides square-wave output. Adjustment of R tunes frequency across a range of 10 to 50 MHz. Different R and C permit band-switching over a 10:1 range of frequencies.



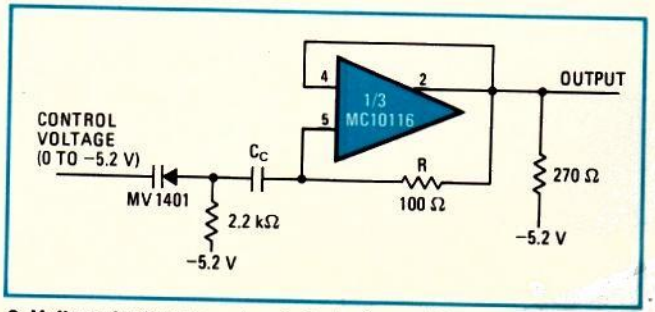
2. Operation. Circuit diagram shows how ECL oscillator operates. Output voltage is fed back to Q_4. Capacitor voltage at pin 5 tries to reach voltage at pin 4, causing output to switch between different ECL levels. Oscillator can never hang up.

are high, Q_4 conducts and Q_5 is off; the capacitor charges up until Q_5 starts to conduct, whereupon Q_4 cuts off and the voltage at pins 2 and 4 drops. The capacitor then discharges; when the capacitor voltage gets low enough, Q_4 starts to conduct, Q_5 cuts off, and the voltage at pins 2 and 4 jumps up. Thus, the capacitor voltage at pin 5 chases the voltage at pins 2 and 4, but never reaches their level because of the limited gain of the amplifier (approximately 8).

Values of R and C are not critical. The resistance of R can be as high as several kilohms or as low as 20 ohms. As R becomes smaller, pull-down resistor R_{PD} must also become smaller to keep emitter-follower Q_2 in conduction. For maximum oscillation frequency, R can be 20 ohms and C a few picofarads. The adjustable oscillator in Fig. 1 oscillates at frequencies in the range from 10 to 50 megahertz. Other choices for C and R can produce osillation at frequencies ranging from audio to vhf.

The frequency equation is inaccurate at the upper ranges because of propagation time, stray capacitance, and the difference between charge and discharge impedances presented at the output. It is desirable to buffer the oscillator through a second stage of the ECL IC.

Use of a varactor diode in place of capacitor C, as shown in Fig. 3, makes the circuit a voltage-controlled oscillator. A varactor with a capacitance range of 10:1, such as the MV1401, works well. Coupling capacitance C_C can be much larger than the diode capacitance, or can be chosen to limit the range of deviation. The oscillator in Fig. 3 operates at (15 ±10) MHz for a voltage swing of 0 to −5.2 volts at the VCO input. □



3. Voltage tuning. Varactor diode in place of C makes circuit a voltage-controlled oscillator. This VCO operates at (15 ±10) MHz.