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capacitance-frequency converter

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This simple circuit will produce a pulse train whose (average) frequency is directly proportional to the value of a capacitor which is to be tested. This waveform can thus be fed direct to a frequency counter which will then indicate the capacitance value in (tens of) picofarads.

The circuit is based on a monostable multivibrator whose pulse width is given by:

$$t = C_X \cdot R_X \cdot \ln 2.$$

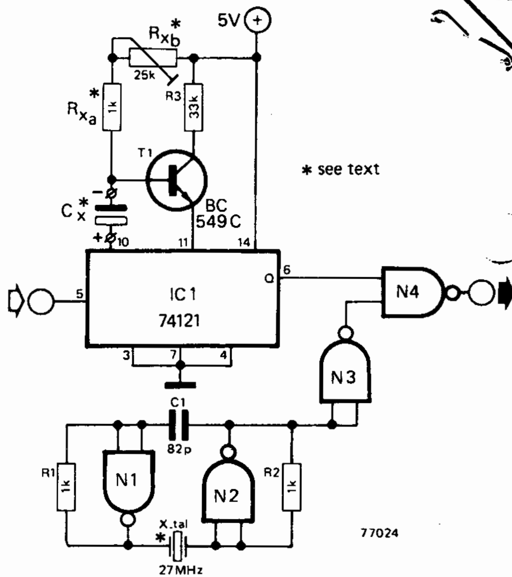
If R_X is fixed then t is obviously proportional to C_X.

The output pulse of the monostable is used to gate pulses from a stable oscillator through to the input of a frequency counter. The number of pulses allowed through to be counted is thus proportional to t which is proportional to C_X.

The reference oscillator uses a normal 27 MHz (model control band) third overtone crystal, but in this circuit it oscillates at its fundamental of around 9 MHz. The monostable IC1 is triggered by gate pulses from the frequency counter and allows pulses from the oscillator through N4 to the counter input. For the circuit to function correctly the counter gate period must be longer than the longest period of the monostable, which with the values shown is around 20 ms.

To calibrate the circuit a capacitor of accurately known value is connected across the C_X terminals and the preset is adjusted until the count indicated is equal to the capacitance value in tens of picofarads, e.g. a 10 n capacitor should give a count of 1000 (not 10 000!). Any 1% silver mica capacitor of greater than 1000 pF can be used for this purpose. In order that the calibration of the circuit should not be affected by temperature R_{Xb} should be a good-quality multiturn cermet trimmer.

With the values shown the circuit will measure capacitance values from 1000 pF to 1 μF. The range may be extended to include higher values by reducing the value of R_X.



N1...N4=IC2=7400