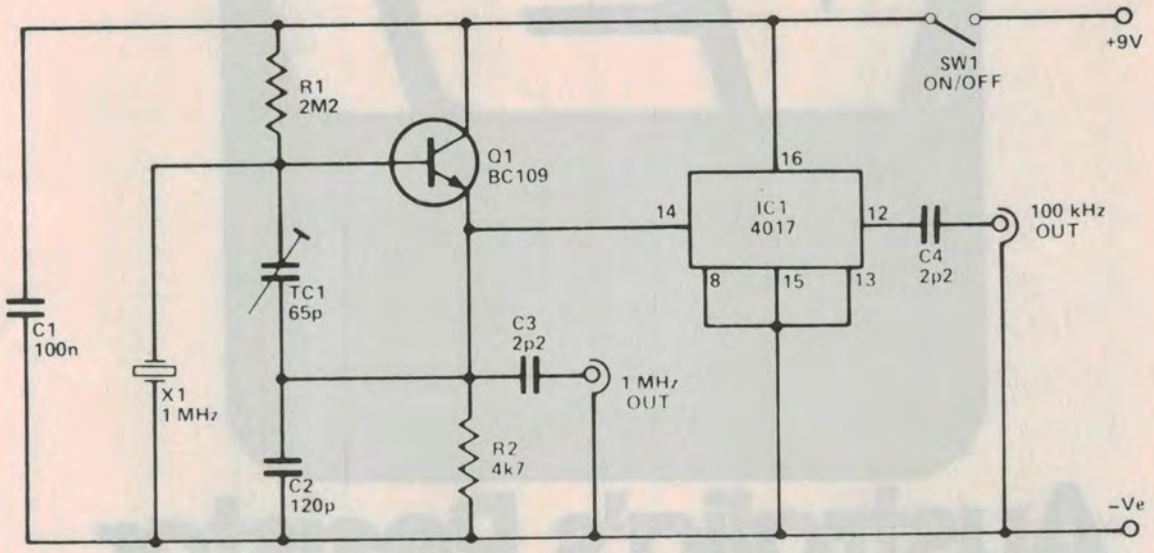
Crystal calibrator for shortwave



A PROBLEM with home-constructed shortwave receivers is that of providing the finished unit with an accurately calibrated tuning dial. A crystal calibrator solves this problem by providing numerous calibration signals that enable the various dial frequencies to be marked on with good accuracy.

A crystal calibrator is also useful for checking the calibration of a shortwave receiver that has been in use for some time.

The calibrator circuit shown here has fundamental outputs at 1 MHz and 100 kHz. However, it does not merely provide calibration signals at these frequencies, but also at harmonics of these frequencies. Harmonics are merely multiples of the fundamental frequencies.

The 1 MHz output therefore provides calibration signals at 2 MHz, 3 MHz, 4 MHz, etc., while the 100 kHz output provides signals at 200 kHz, 300 kHz, 400 kHz, etc. These additional frequencies are produced because the circuit is designed to give an output signal that is not a sinewave, but instead has a very rapid risetime and is virtually a squarewave. This gives a signal which is rich in harmonics at frequencies up to many megahertz.

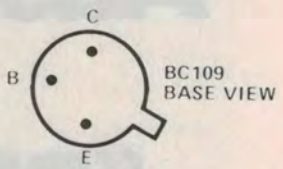
This circuit provides harmonics that are readily detectable up to 30 MHz (the upper limit of the shortwave spectrum) on any reasonably sensitive receiver.

The circuit

Q1 is used in a simple 1 MHz Colpitts crystal oscillator with output taken from the emitter, loosely coupled via C3 (2p2).TC1 and C2 effectively form a tap on the crystal which acts as a parallel tuned circuit. The output of Q1 is coupled into this tapping, and this gives the positive feedback path needed to produce oscillation. The circuit oscillates at the resonant frequency of the crystal since there is only an efficient feedback path at this frequency via the crystal. There is a voltage step-up action due to the very high Q of the crystal which ensures that there is sufficient feedback to produce strong oscillation and an output rich in harmonics. A crystal is used in the unit rather than an ordinary L-C tuned circuit as a crystal gives better accuracy and stability.

The 100 kHz output is obtained merely by feeding the 1 MHz signal to a CMOS 4017 divide by ten circuit.

TC1 must be adjusted to give optimum accuracy from the unit, and this is easily achieved by connecting a short lead to the 1 MHz output and placing it near to a receiver tuned to either VNG (Lyndhurst, Victoria) on 12 MHz or WWV/WWVH on 10 MHz or 15 MHz. This will produce a low frequency beat note (heard either as a whistle or as a cyclic rise and fall in the volume of the station), and TC1 is simply adjusted for the lowest attainable beat note. A beat rate of well under one per second should be easily obtained.



Construction

Construction is generally non-critical. However, C1 should have short leads and connect as directly as possible between the collector of Q1 and the junction of R2 and C2. Keep the leads to the crystal short also.

The unit is best mounted in a shielded box — such as a diecast box, and coax connectors used for the two outputs.

Many transistor types may be substituted for Q1 — such as: 2N3564, 2N2222, 2N5770, BC107, BC547, BC108, BC548, BC549 etc. TC1 can be a compression type trimmer, circular film trimmer or a beehive type (Philips). A trimmer having a maximum value of 100 pF or 50 pF may be substituted as most crystals are made to operate into a 30 pF or 32 pF load. Some are made to operate into a 50 pF load, others into a 100 pF load. Stray capacitance and b-e junction capacitance in Q1 will account for some of the load capacitance.

Current consumption is around four to five milliamps. ●