

## 6 A simple metronome

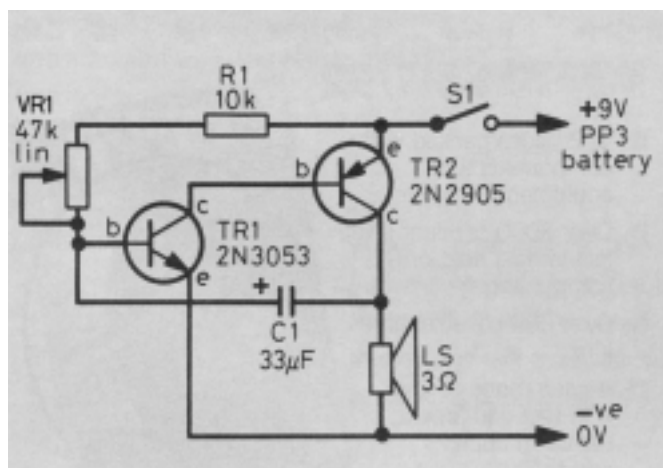
### Introduction

A metronome is a device used by musicians to indicate the tempo of a piece of music. Until electronics came on the scene, this 'beating of time' was achieved in much the same way as a clock keeps time, i.e. with a pendulum device, the clicking of the escapement indicating the beats of the music.

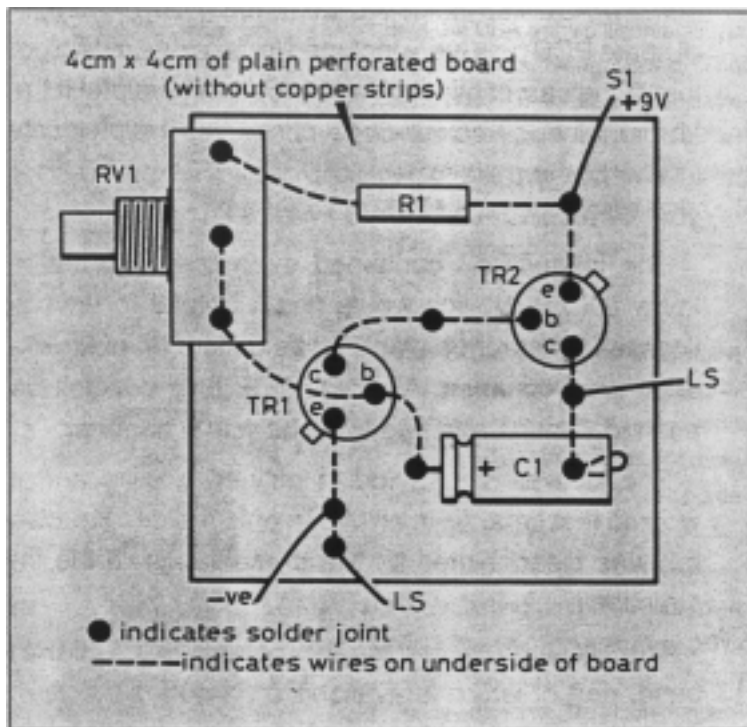
Those of you who have already built the Morse Key and Buzzer from the designs in this book, will recognise the circuit of this metronome – it is exactly the same as was used to produce the note of the buzzer. This circuit is shown in **Figure 1**.

### The circuit

Three components determine the speed at which the circuit oscillates – the speaker (LS), the resistors (VR1 + R1) and the capacitor (C1). VR1 is a variable resistor, so that the speed at which the oscillator operates can be varied. Compared with the component values of the Morse Buzzer (which operated at around 800 Hz), these components now give an oscillation frequency of around 1.25 Hz, which is far too low to be heard as a note. What we *do* hear, however, is a series of clicks, as the voltage across the speaker changes quickly from 0 to 9 V and back again.



**Figure 1** The metronome circuit is rather like the Morse oscillator



**Figure 2** The component wires are pushed through holes in the circuit board and joined together underneath

Variation of speed could be achieved by varying resistance or capacitance. However, as you may already know, variable capacitors have values in the picofarad range, not the tens of microfarads used here, so it is very simple to employ a variable resistor (potentiometer) to control the oscillator. You could use a multi-way switch to switch in one of several capacitors, as well as having the variable resistor, but this was found to be an unnecessary complication. This design operates between about 100 clicks per minute and 200 clicks per minute.

## Making the prototype

A single piece of plain matrix board (no copper strips) measuring about  $40 \times 40$  mm is sufficient to hold all the components except the potentiometer and switch (see later). The case can be plastic or aluminium, and one measuring  $65 \times 100 \times 50$  mm is about right. Make sure there are holes in the case beside the speaker cone to let the sound out, and larger holes for the potentiometer and switch. If a potentiometer is used with a combined ON/OFF switch, then the extra hole for the switch is not necessary! It is advisable to construct the circuit *before* putting it in the

box, so that it can be tested to ensure that everything is working. If it is, then you can exercise your ingenuity in mounting the speaker, battery and board inside the box. A final test can be made before starting the calibration process.

## Calibration

There is no ‘easy’ way to do this. The frequencies involved are too low to be measured with the average frequency counter, so you will need to resort to using a stopwatch and counting the number of clicks per minute.

### Parts list

Resistors: 0.25 watt, 5% tolerance

R1 10 kilohms ( $k\Omega$ )

VR1 47 kilohms ( $k\Omega$ ) linear potentiometer

Capacitor

C1 33 microfarads ( $\mu F$ ) electrolytic

Transistors

TR1 2N3053 npn

TR2 2N2905 pnp

Additional items

S1 SPST ON/OFF switch

LS 3 ohms ( $\Omega$ ) loudspeaker

Knob with pointer for VR1

PP3 battery and connector

Aluminium case,  $65 \times 100 \times 50$  mm

Matrix board (plain),  $40 \times 40$  mm