The bistable draws a current of about 12 mA only, the larger part of which flows through the LED.

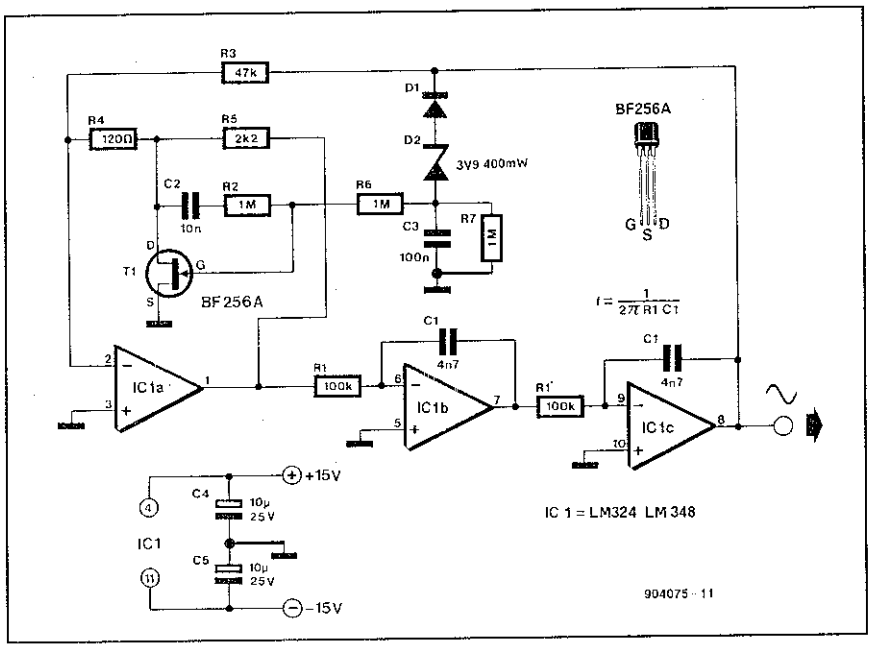
Capacitor C2 ensures that the bistable is reset when the supply is switched on: after that the LED must thus be out ■

(J. Ruffell)

SINE WAVE GENERATOR 024

The frequency of the generator presented here is determined by integrators IC1b and IC1c. An integrator has two properties that are used in this design. Firstly, there is a phase shift of 90° between input and output (ignoring for the moment the non-ideal behaviour of the opamp), and secondly, its amplification is −1 (i.e. inversion of signal), provided the frequency

$f = 1/2\pi R1C1$



Cascading two identical integrators will thus result in an overall phase shift of 180° and an amplification of unity (provided the frequency is $1/2\pi R1C1$): an ideal basis for an oscillator.

The two integrators are connected in the feedback circuit of an amplifier whose gain is determined by the amplitude of the output signal. Consequently, the generator has a reasonably stable output voltage (at a level of about 4.5 V p-p).

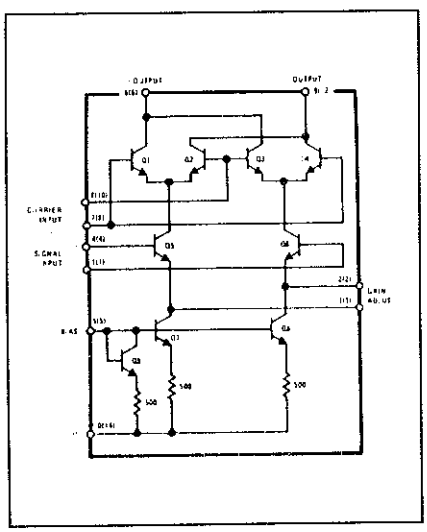
With the values of C1 (C1') and R1 (R1') as shown in the diagram, the output has a frequency of about 300 Hz. The frequency may be varied by replacing R1 and R1' by a stereo potentiometer. To keep the frequency setting within bounds, the overall range of this potentiometer should not exceed a decade.

The maximum attainable frequency is about 5 kHz. Distortion is not greater than 0.1%. The current drawn by the generator is only a few milliamperes.

Finally, the LM348 is a quadruple 741; it is thus possible to construct the generator from four 741s ■

(G. Boddington)

FREQUENCY DOUBLER 025



Internal circuit of the LM1496.

It is often required that the frequency of a signal be doubled: modulator/demodulator chip LM1496 is an ideal basis for this.

From trigonometry it is well known that

$2\sin x\cos x = \sin 2x$

and

$\sin^2 = 1 - \cos 2x$

These equations indicate that the product of two pure sinusoidal signals of the same frequency is one signal of double that frequency. The purity of the original signals is important: composite signals would give rise to all sorts of undesired product.

The LM1496 can process only signals of not greater than 25 mV: above that serious distortion will occur. The design is therefore provided with a potential divider at its input. This makes it possible, for instance, to arrange for a 500 mV input signal to result in a signal of only 25 mV at the input of the LM1496.

To provide a sufficiently high output signal, the output of IC1 is magnified by opamp IC2, which is connected as a non-inverting amplifier. Since the output of IC1 contains a d.c. component of about 8 V, the coupling between the two stages must be via a capacitor, C4.

With values of R15 and R16 as shown, IC2 gives an amplification of 16 (24 dB). The overall amplification of the circuit depends on the level of the input signal: with