zero crossing detector 25

This circuit will detect precisely the negative-going zero-crossing point of an AC waveform, but requires only a single supply voltage, unlike zero crossing detectors using op-amps. N1 and N2 are Schmitt triggers connected to form a monostable multivibrator with a period of about 15 ms. P1 is adjusted so that when the input voltage falls to zero the voltage at the input of N1 is equal to the low-going threshold of the Schmitt trigger. The output of N1 thus goes high and the output of N2 goes low. C1 holds the second input of N1 below its positive-going threshold for about 15 ms, during which time the output of the circuit will remain low, even if noise pulses on the input waveform should take the first input of N1 high.

When the input signal goes positive the first input of N1 is taken above its positive-going threshold. Note that this occurs after the positive-going zero-crossing point due to the hysteresis of the Schmitt trigger. Subsequently the second input of N1 goes high due to C1 charging through R3. The circuit then resets and the output of N2 goes high. The output of N2 is thus an asymmetrical squarewave whose negative-going edge occurs on the negative-going zero-crossing point of the input waveform and whose positive-going edge occurs sometime during the positive half-cycle of the input waveform. The negative-going edge of the waveform is independent of the amplitude of the input signal and occurs always at the zero-crossing point. However, it does vary slightly with supply voltage, so this should be stabilised. If a higher supply than 15 V is used then R4 and D2 must be included, otherwise the IC may be damaged.

To calibrate the circuit an oscilloscope is desirable so that P1 may be set exactly for the zero-crossing point. Alternatively, if a 'scope is not available, C1 should be temporarily disconnected and the output of N2 monitored on a multimeter.

In table 1 look up the voltage corresponding to the RMS input voltage and supply voltage and adjust P1 until this voltage registers on the meter. e.g. with a 10 V supply and a sinewave input of 5 V RMS P1 should be adjusted until the meter reads 4.47 V.

R1, D1 and the input protection diodes of N1 protect the circuit against input voltages up to 220 V (RMS, sinewave input). At this level the maximum permissible current of 10 mA flows into N1 and 1.5 W are dissipated in R1. If higher input voltages are to be used or less dissipation is desirable then the values of R1, R2 and P1 should be increased, keeping them in the same ratio.

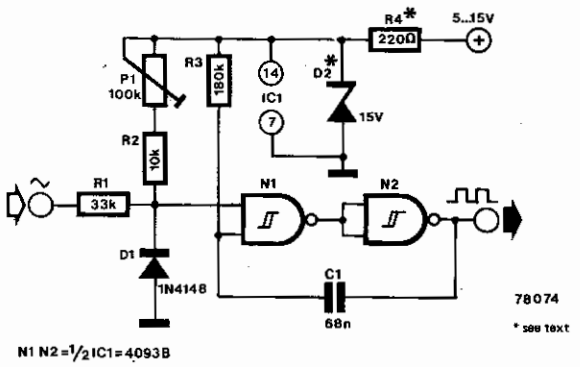

Table 1

Input voltage (RMS sine)	Supply voltage 5 V	10 V	15 V
2 V	2.24	3.49	——
3 V	2.33	4.09	5.18
4 V	2.37	4.33	5.91
5 V	2.40	4.47	6.26
6 V	2.42	4.56	6.48
7 V	2.43	4.63	6.64
8 V	2.44	4.67	6.75
9 V	2.44	4.71	6.83
10 V	2.45	4.74	6.90