



Using a single LM324 quad op-amp IC a versatile threshold comparator may be constructed. The circuit will sound an alarm and/or energise a relay whenever the input voltage falls outside preset levels. The circuit may be adjusted to respond to the three following conditions.

- Input voltage falls below a preset level.
- Input voltage rises above a preset level.
- Input voltage falls inside a range of voltages defined by upper and lower limits (window comparator).

Op-amps A1 and A2 function as comparators. When the voltage on the inverting input of A1 falls below the preset reference voltage on the non-inverting input the output voltage will go high. When the voltage on the non-inverting input of A2 rises above the preset voltage on the inverting input the output will go high. For use as a window comparator inputs 1 and 2 should be linked. When one or both outputs go high

T3 will be turned on, energising the relay. The astable multivibrator built around A3 will begin to oscillate and will feed a train of short pulses at about 1.5 kHz to the amplifier comprising T1 and T2, thus sounding the alarm. A4 provides a stable 6 volt reference for the comparators. Coarse adjustment of the reference voltages is provided by P2 and P5 and fine adjustment by P1 and P4. Hysteresis is provided, which is variable by means of P3 and P6. This is particularly useful if the input signals are noisy.

The relay should have an operating voltage of 9 V or less, but if it is less than a suitable resistor must be included in series with the relay to drop the excess voltage.

The maximum input voltage to inputs 1 and 2 is 25 V and the input resistance is 1 M $\Omega$ , but the input voltage (and resistance) can be increased by raising the value of R2 and R7.