

# deep-freeze alarm

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The alarm described has been in continual use for over a year at a temperature of around  $-18^{\circ}\text{C}$ , which is, of course, quite normal for a deep-freeze alarm. Its function is to indicate an accidental rise in temperature. There are, of course, indicators provided on the deep-freeze unit, but as these are mains-operated they are of not much use in case of mains failure!

The principle of operation is quite simple: a green LED lights as long as the temperature stays within limits defined by the user, while a red LED shows when the temperature has risen above a critical level.

Since operational amplifier IC<sub>1</sub> is arranged as a differentialiator, two possible states ensue: (a) the output voltage is positive as long as the potential at the non-inverting input is higher than that at the inverting input, and (b) the output voltage is negative when the input levels are reversed with respect to those in (a). The voltage at the non-inverting input is derived from potential divider  $R_2$ - $R_3$ - $P_1$  and is set by the user. The voltage at the inverting input varies with temperature. The sensor is formed by the base-emitter junction of n-p-n transistor T<sub>1</sub>, which can be almost any type. The value of resistors  $R_2$  and  $P_1$  depends on the transistor used. The values stated in the circuit diagram pertain to a 2N1711, a threshold temperature of  $-15^{\circ}\text{C}$ , and a supply voltage of  $\pm 4.5\text{ V}$ .

If more than a visual indication is required, the circuit may be used to control an additional audible alarm. When D<sub>2</sub> lights, transistor T<sub>2</sub> is saturated, so that its collector is nearly at earth potential. This transistor can, therefore, operate a small buzzer or

siren, or, indeed, anything else convenient to you. The additional alarm must be connected between S+ and S-.

If you are happy with the LED indication, transistor T<sub>2</sub> may be omitted and resistor  $R_5$  replaced by a wire link.

If only periodic checks are to be carried out, the circuit may be supplied from two 4.5...9 V dry batteries via a spring-loaded push-button switch. Where permanent monitoring is desired, however, it is advisable to use two 6...9 V rechargeable NiCd batteries (without a switch). The current drawn by the buzzer or siren should not exceed 500 mA.

