Depending on circuit design, NTC thermistors with rated resistances from 3.3 to 68 kΩ are used (10 kΩ with 5% tolerance is most common).

Type M891 from Siemens Matsushita Components is ideal for this application. In some fans, the control circuit is combined with the electronic motor commutation circuit and assembled in the rotor of the motor.

**NTC thermistors in LCDs**

As the fluid used in liquid crystal displays is sensitive to temperature, LCD modules have a limited operating temperature range. If a constant voltage is applied, LCD contrast increases with temperature. On the other hand, low temperature means low contrast. In fact, the threshold voltage of the liquid crystal has a negative temperature coefficient characteristic of typically 6 mV per kelvin. Some method is therefore needed to maintain optimum contrast over a wide temperature range. This problem can best be solved with NTC thermistors.

**Temperature range of LCD modules**

LCD modules are available for two temperature ranges – standard and extended. Standard displays are intended for indoor use, extended displays for outdoors and rugged environments. Standard displays can be operated in the range from 0 to 50 °C and normally require no temperature compensation because variation of contrast with temperature is only slight. In extended modules, however, which operate between –20 and +70 °C, a compensation circuit is often used.

**How LCDs work**

Liquid crystal displays (LCDs) are widely used in modern electronic devices such as mobile and wireline telephones, pagers, calculators, watches, portable CD players and numerous instruments. LCDs are passive devices which operate by manipulating ambient light. An LCD consists of two plates of thin glass separated by a layer of liquid crystal fluid. The liquid crystal material is a mixture of fluid with a large number of long cylindrically shaped crystals. The inner surfaces of the glass plates are patterned with the transparent electrodes, the outer surfaces are bonded to sheets of polarized material to create the desired visual effect when the field voltage is applied to the electrodes.

**Summary**

NTC thermistors have vast potential for temperature measurement in automation and control applications. The specimen circuits presented here illustrate their versatility.