Application Note

Temperature Compensation for LCD displays

The optimal contrast setting for LCD displays varies with ambient temperature. For most applications this variation in contrast is tolerable over the “normal” temperature range of 0°C to +50°C. Most LCD modules are available with an extended temperature range option which allows the display to operate from -20°C to +70°C. The changes in contrast are NOT usually tolerable over this wide a range of temperatures, which means a way of adjusting the contrast voltage as the ambient temperature changes must be provided.

As the temperature decreases the LCD fluid requires a higher operating voltage in order to maintain a given optical contrast. See figure #1. One way to provide for this is to give the user control of the contrast. This is a simple solution but quite often its not desirable or practical.

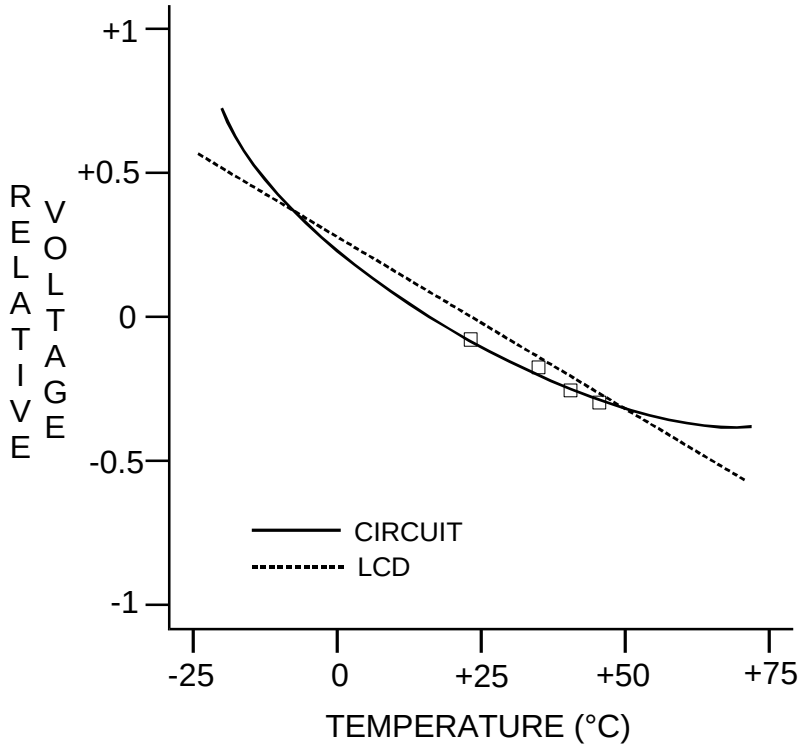

Figure #1. Temperature compensated voltage provided by the circuit in Figure #2 (solid line). The dashed line describes the way in which the LCD operating voltage varies with temperature.

The chart can be used to predict the voltage at VL needed to produce good contrast on the display by adding the “relative voltage” to the contrast voltage of the display at 25°C. If, for instance, a display looks good with -3v on V_L at room temperature (25°C) this display will need -2.7v at 50°C.

The controlling microprocessor could measure the ambient temperature and supply the proper voltage to the LCD, but this is complicated and expensive.

The most common solution to the temperature compensation problem is to provide a circuit such as that in Figure #2 to adjust the contrast voltage automatically.

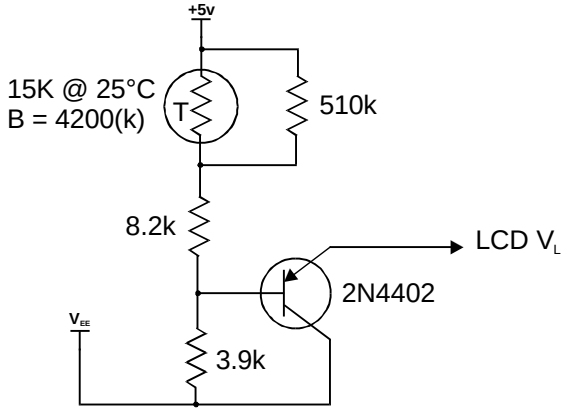

Figure #2. Schematic diagram, simple compensation circuit.

This circuit uses a negative temperature coefficient thermistor to sense the ambient temperature. It should be placed as physically close to the LCD module as possible. The PNP transistor is connected as an emitter follower to provide the drive current to the LCD's contrast voltage (V_L) input.

The voltage V_{EE} will vary depending on the requirements of the LCD. NOTE: V_L and V_{EE} are measured in relation to the V_{DD} supplied to the LCD. An extended temperature range character display will require about -7.8v at its V_L input at 25°C or about -2.8v relative to ground. The V_{EE} voltage will need to be about 25% higher than the actual voltage required at the V_L input of the LCD. During development the V_{EE} should be a variable voltage that can be used to adjust the contrast to an optimal level. The V_{EE} can be made fixed or adjustable for the production units.

This circuit will work for all character modules and graphic modules up to 320 x 240. Modules larger than this are not available with the extended temperature option.