LED Back Light Drive Methods

Introduction:

LED back lights for LCD modules are generally driven with a DC voltage through a current limiting resistor. This approach is acceptable for most applications.
This application note discusses issues such as extra bright display requirements, lowest possible power consumption rates and back lights controlled over a wide brightness range.

Description:

By using a pulse width modulation scheme, several advantages are realized over a simple DC voltage method. The main advantage is in efficiency. The LED's are pulsed with a high current for a short period of time. For example consider the NHD-0216K1I. The nominal LED driving current for this display is 120mA which produces a typical brightness of 50 NIT. If, instead of a DC or constant current, we apply 5 times the current (600mA), for 1/5 of the time, the average current is the same (120mA). See **Fig.1**
The brightness average of the LED would also be the same if measured by a meter. The only difference is the **PERCEIVED** brightness.

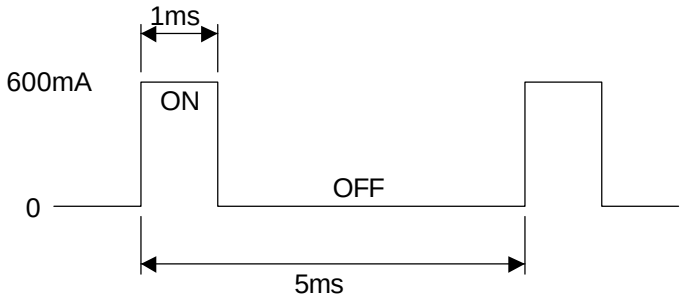

Fig.1

The human eye has a certain degree of persistence. If exposed to a bright light the eye will **remember** the light for a short period of time. This allows us to view a motion picture or television screen as a steady image when in fact it is flickering at 24 to 30 times per second. When the LED is flashed "ON" for a short period of time and then turned off the eye **remembers** the light at the high brightness level. The result is that the perceived brightness of the back light is closer to the high pulsed brightness than to the lower DC brightness.

This effect provides several advantages as follows...

If the brightest possible back light is required, the display can be pulsed at a 1:4 on/off ratio with five times the typical current. The pulse frequency repitition should be greater than 100Hz but not greater than 1,000Hz, so the flickering is not perceived by the eye.

This technique can also be used to provide a normal looking brightness level to the display but at a **lower average current** to save power. The average power can be cut by a factor of at least 50% to produce a given perceived brightness level. This may provide a big advantage in battery operated products.

Another use of this method is to facilitate a wide range brightness control for the LED back light. By adjusting the on/off ratio, a wide range of brightness can be achieved while maintaining a very even back light appearance. See **Fig.2** . One can also vary the brightness by adjusting the DC current to the LED's but at low current the individual LED emitters start to become visable resulting in an uneven looking back light. To implement this technique, the peak current should be set at the specified typical current for the display and the on/off ratio of the pulses varied from near 100% on to near 0% on.

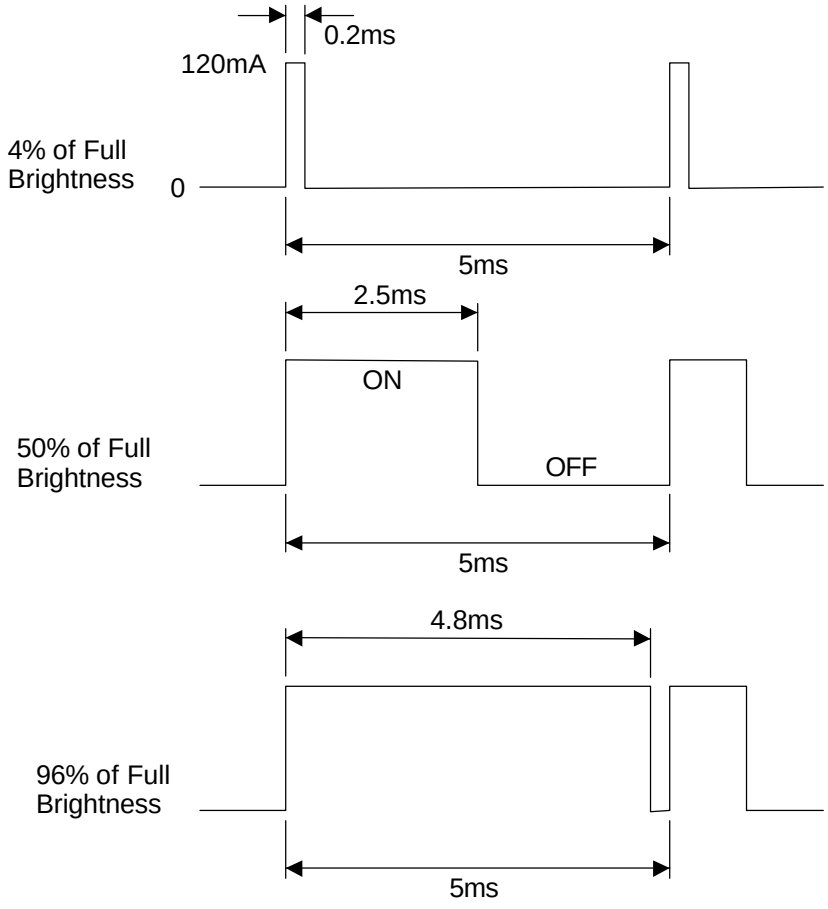

Fig. 2