DPP to Control LED Brightness

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Light-emitting diodes (LEDs) require a regulated current, and their brightness is proportional to the current that flow through them. Some LED drivers use an external resistor to set the LED current. A digitally programmable potentiometer (DPP™) can replace a discrete resistor with the advantage of providing an adjustable value allowing the LED brightness to dynamically change. Most DPP circuits have the ability to store permanently the resistor value in non-volatile memory.

This application brief shows a DPP circuit used in combination with the CAT32 white LED driver. The digitally programmable potentiometer is connected as a 2-terminal variable resistor, as shown on Figure 1. The potentiometer Wiper-to-Low resistor (between W and L pins) is connected in series with the R_{SET} resistor to adjust the LED brightness. This example uses a 32-tap linear potentiometer, the CAT5114, with a end-to-end resistance of 50kΩ. The wiper terminal (W) position is controlled through a 3-wire interface. The $\overline{INC}$ input increments the wiper in the direction which is determined by the logic state of the Up/$\overline{Down}$ input. The $\overline{CS}$ input is used to select the device and also store the wiper position prior to power down.
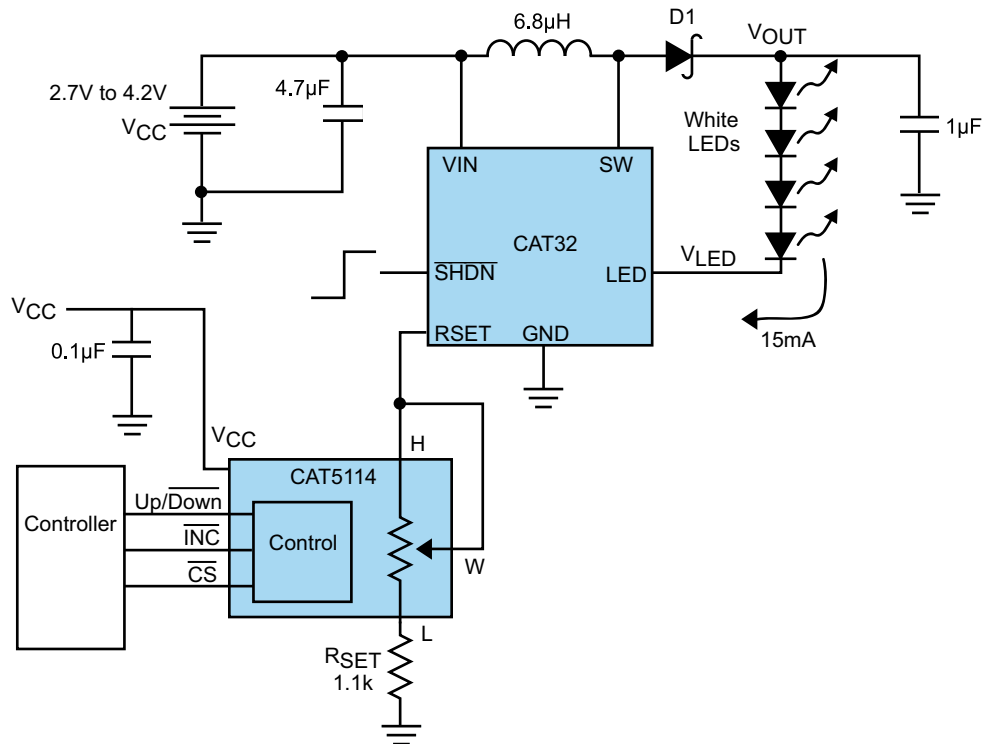

Figure 1. CAT32 LED Driver with CAT5114 Potentiometer Circuit Diagram

LED CURRENT

The LED current is a function of the total resistance connected to the R_{SET} pin, and is calculated as follows:

$$I_{LED} = \frac{22.5}{R_{SET} + R_{W-L}}$$

R_{SET} defines the minimum resistance and therefore the maximum LED current, for example with RSET = 1.13kΩ, the LED current is 20mA. The lowest LED current is obtained with the largest R_{W-L} of 50kΩ, which results in an LED current of about 1mA.

The number of taps define the resolution of the potentiometer or the minimum increment in the resistance. A larger number of taps gives more resolution. Table 1 lists a selection of Catalyst DPPs with their characteristics.

Part Number	Number of Taps	Resistor Options (kΩ)	Digital Interface	Resistor Scale	Wiper Memory
CAT5114	32	10, 50, 100	Increment	Linear	1 position
CAT5113	100	10, 50, 100	Increment	Linear	1 position
CAT5116	100	32	Increment	Log	1 position
CAT5115	32	10, 50, 100	Increment	Linear	Volatile

Table 1. DPP Selection

In applications where the LEDs backlight an LCD, such as in cellular phones or PDAs, the LEDs are either turned ON or OFF. The potentiometer can be used to generate a soft fading between those two states.

Information on the DPP products and the LED drivers are available on the Catalyst web site at www.catalyst-semiconductor.com.

CATALYST