

Application Note No. 097

Using BCR402R/BCR402U at High Supply Voltages

Small Signal Discretes



Never stop thinking

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Revision History: 2006-05-08, Rev. 1.0

Previous Version:

Page	Subjects (major changes since last revision)

1 Using the BCR401R / BCR402R and BCR402U / BCR405U Linear LED Driver ICs at High Supply Voltages

1.1 Limitations in normal operation

The BCR401R & 402R have a maximum supply voltage $+V_S$ of 18 V, whereas the BCR402U & BCR405U have a limit of 40 V. The current consumption of each device is also dependent on the supply voltage. Furthermore, the maximum safe output current of these drivers is influenced by the power supply voltage as well, given that the total power dissipation in these drivers is the product of the voltage across the part multiplied by the output current. Many light modules are designed for +24 V operation. This is beyond the maximum ratings of BCR401R and BCR402R if the full supply voltage is fed directly into the $+V_S$ pin (pin 3). For the BCR402U and BCR405U, +24 Volts is still within safe operating limits, but the current used by the driver IC itself increases from a typical value of 420 μA at $+V_S = 10\text{ V}$ to 1.2mA at $+V_S = 24\text{ V}$. The increased current used by the driver IC at higher power supply voltages increases power dissipation within the device without any additional benefit in terms of how well the LED driver does its job.

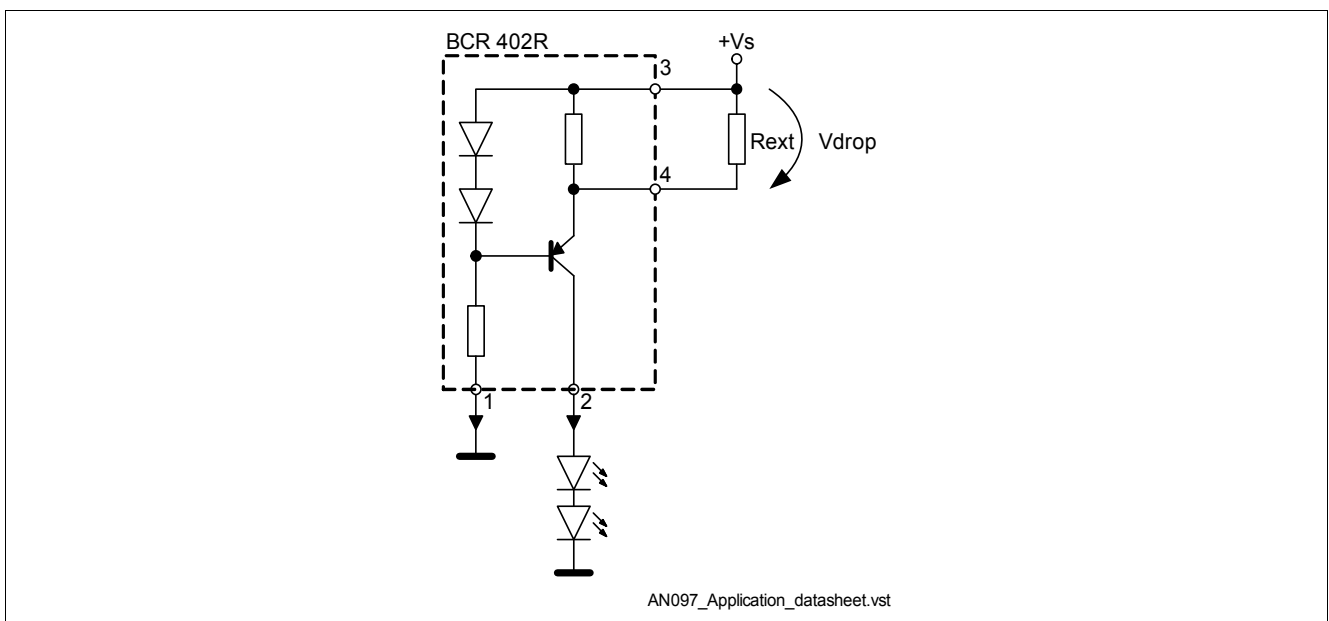


Figure 1 Application circuit of BCR402R in datasheet

Table 1 Maximum ratings

Device	Maximum supply voltage	Maximum total power dissipation
BCR401R	18 V	330 mW @ $T_S \leq 87\text{ }^\circ\text{C}$
BCR402R	18 V	330 mW @ $T_S \leq 87\text{ }^\circ\text{C}$
BCR402U	40 V	500 mW @ $T_S \leq 125\text{ }^\circ\text{C}$
BCR405U	40 V	500 mW @ $T_S \leq 125\text{ }^\circ\text{C}$

1.2 Increasing the operating voltage while remaining within safe operating limits

A simple way or “trick” to reduce the operating voltage seen by the LED driver IC is to use some of the LED’s in the LED string between the power supply $+V_S$ and the power supply pin of the LED driver. In this way, the voltage actually present at the LED driver’s power supply pin is reduced or “dropped” by the forward voltage(s) of the LED(s) that are used between the power supply and the LED driver. One possible implementation is shown in **Figure 2**. In this case, the battery voltage is reduced by the forward voltage V_F of 3 LEDs in series. Note that the current these 3 LED’s pass is nearly identical to the current passed by the 3 LED’s underneath the LED driver, the difference being the current that is consumed by the LED Driver IC itself. This current consumed by the LED driver’s internal circuitry is approximately two orders of magnitude less than the output current of the driver, meaning that the difference in current between the LED’s in the top 3 LED’s and bottom 3 LED’s is negligible. The differences in light output between top and bottom stack of LED’s due to this very small difference in LED operating current is not visible to the human eye, and is even less than the typical variation in light output seen between different samples of the same LED type run at the same exact currents. The key ideas in this approach are 1) the power supply voltage or battery voltage seen by the LED driver IC is reduced to be within safe limits by using LED’s to drop the supply voltage and 2) the power dissipation in the LED Driver IC is reduced, as the voltage across the LED Driver is also reduced. The optimal number of LED’s to use in the ‘upper stack’ is determined by the available power supply voltage, the forward voltages of the LED’s used, power dissipated in the LED driver IC, and the ‘overhead’ or voltage needed across the LED driver for proper operation (typically 1.4 Volts for the BCR402U).

Using the BCR401R / BCR402R and BCR402U / BCR405U Linear LED Driver

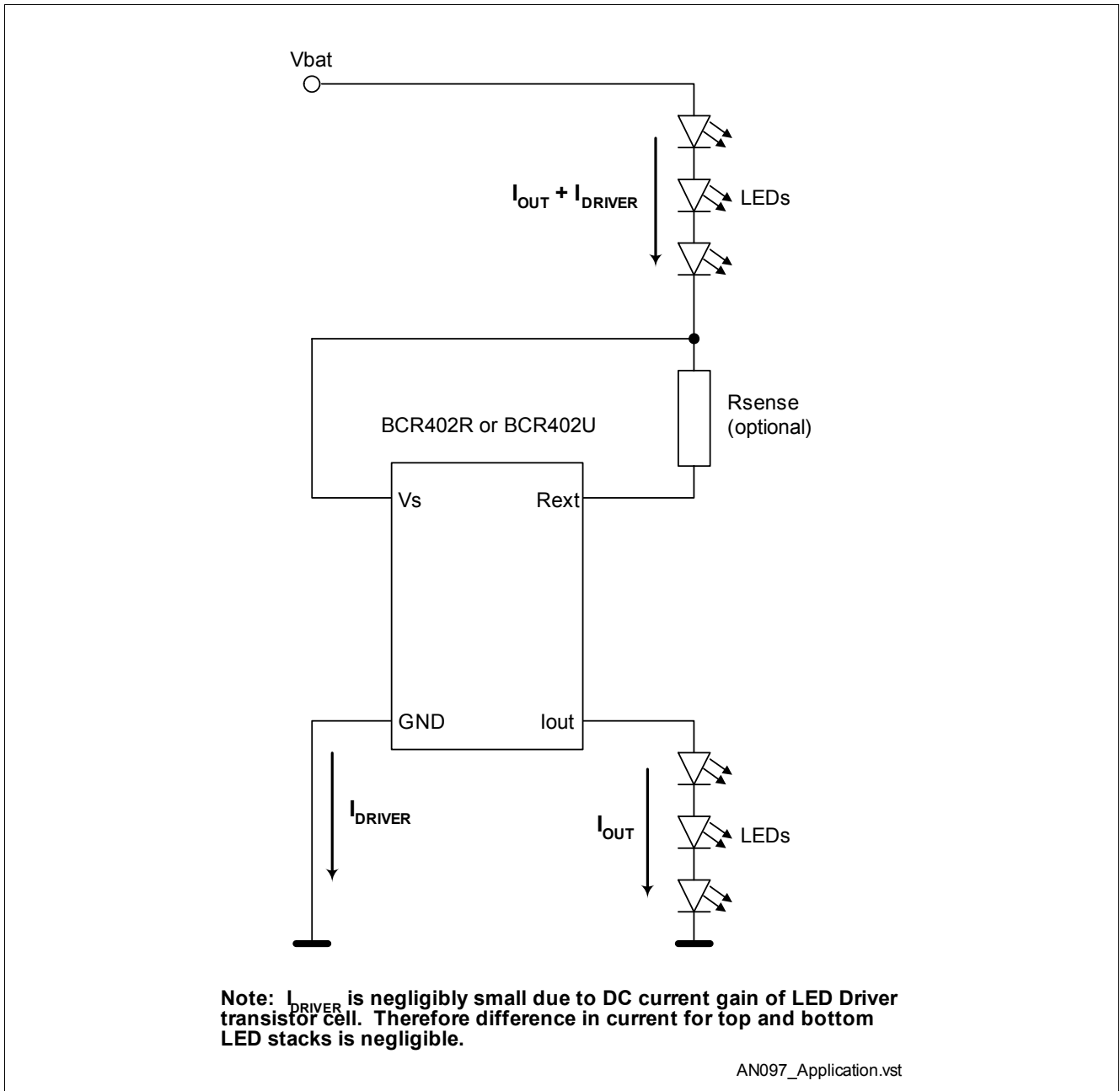


Figure 2 Application circuit using BCR402U or BCR402R at high supply voltages