

## **1 LED Driver**

### **1.1 Features**

- LED drive current preset to 20 mA
- Output current adjustable up to 65 mA with an external resistor
- Easy paralleling of drivers to increase current
- Supply voltage up to 40 V
- High current accuracy at supply voltage variation
- Low voltage overhead of 1.4 V
- Up to 750 mW power dissipation in a small SC74 package
- Negative thermal coefficient of -0.2 %/K reduces output current at higher temperatures
- RoHS compliant (Pb-free) package
- Automotive qualified according AEC Q101

### **1.2 Applications**

- Channel letters for advertising, LED strips for decorative lighting
- Aircraft, train, ship illumination
- Retrofits for general lighting, white goods like refrigerator lighting
- Medical lighting
- Automotive applications like CHMSL and rear combination lights

### **1.3 General Description**

The XB402U is a cost efficient LED driver to drive low power LEDs. The advantages towards resistor biasing are:

- homogenous light output despite varying forward voltages in different LED strings
- homogenous light output of LEDs despite voltage drop across long supply lines
- homogenous light output independent from supply voltage variations
- longer lifetime of the LEDs due to reduced output current at higher temperatures (negative thermal coefficient)

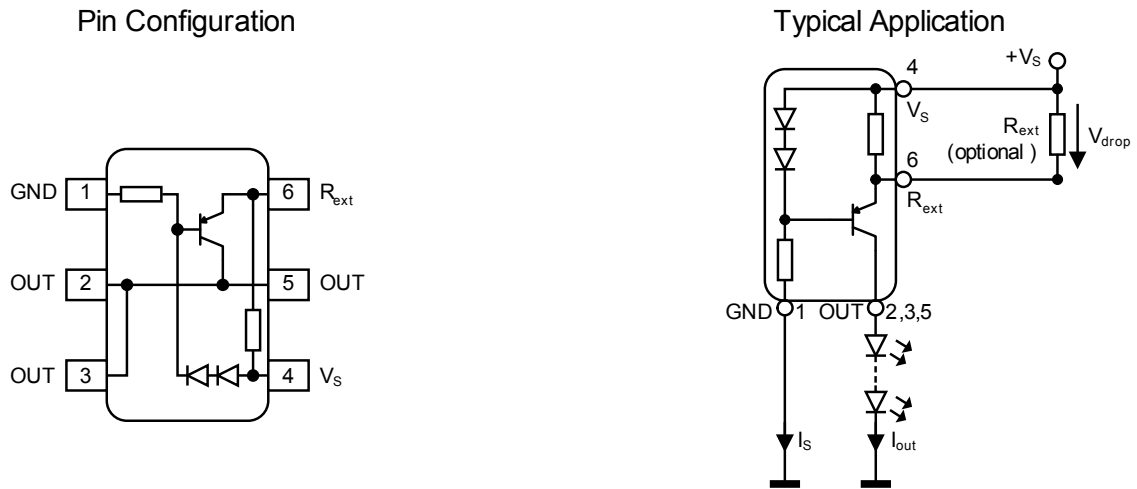
The advantages towards discrete solutions are:

- lower assembly cost
- smaller form factor
- higher reliability due to less soldering joints
- higher output current accuracy due to pretested LED drivers

Dimming is possible by using an external digital transistor at the ground pin.

The XB402U can be operated at higher supply voltages by putting LEDs between the supply voltage  $V_S$  and the power supply pin of the LED driver. You can find further details in our application notes.

The XB402U is a perfect fit for numerous low power LED applications by combining small form factor with low cost. These LED drivers offer several advantages to resistors like significantly higher current control at very low voltage drop ensuring high lifetime of LEDs.



**Figure 1-1 Pin configuration and typical application**

Sales Name	Marking	Pin Configuration				Package
		1 = GND	2; 3; 5 = OUT	4 = $V_s$	6 = $R_{ext}$	
XB402U	L279	1 = GND	2; 3; 5 = OUT	4 = $V_s$	6 = $R_{ext}$	SC74-6

## 2 Electrical Characteristics

**Table 2-1 Maximum Ratings at  $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise specified**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Supply voltage	$V_S$	-	-	40	V	
Output current	$I_{out}$	-	-	65	mA	
Output voltage	$V_{out}$	-	-	40	V	
Reverse voltage between all terminals	$V_R$	-	-	0.5	V	
Total power dissipation	$P_{tot}$	-	-	750	mW	$T_S \leq 112.5\text{ }^\circ\text{C}$
Junction temperature	$T_J$	-	-	150	$^\circ\text{C}$	
Storage temperature range	$T_{STG}$	-65	-	150	$^\circ\text{C}$	

**Attention: Stresses above the max. values listed here may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. Maximum ratings are absolute ratings; exceeding only one of these values may cause irreversible damage to the integrated circuit.**

**Table 2-2 Thermal Resistance at  $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise specified**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Junction - soldering point <sup>1)</sup>	$R_{thJS}$	-	-	50	K/W	

1) For calculation of  $R_{thJA}$  please refer to Application Note AN077 (Thermal Resistance Calculation)

**Table 2-3 Electrical Characteristics at  $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise specified**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Collector-emitter breakdown voltage	$V_{BR(CEO)}$	40	-	-	V	$I_C = 1\text{ mA}$ , $I_B = 0$
Supply current	$I_S$	340	420	500	$\mu\text{A}$	$V_S = 10\text{ V}$
DC current gain	$h_{FE}$	100	220	470	-	$I_C = 50\text{ mA}$ , $V_{CE} = 1\text{ V}$
Internal resistor	$R_{int}$	38	44	52	$\Omega$	$I_{Rint} = 10\text{ mA}$
Output current	$I_{out}$	18	20	22	mA	$V_S = 10\text{ V}$ $V_{out} = 8.6\text{ V}$
Voltage drop ( $V_{Rext}$ )	$V_{drop}$	0.8	0.85	0.9	V	$I_{out} = 20\text{ mA}$

**Table 2-4 DC Characteristics with stabilized LED load at  $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise specified**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Lowest sufficient supply voltage overhead	$V_{Smin}$	-	1.4	-	V	$I_{out} > 18\text{ mA}$
Output current change versus $T_A$	$\Delta I_{out}/I_{out}$	-	-0.2	-	%/K	$V_S = 10\text{ V}$
Output current change versus $V_S$	$\Delta I_{out}/I_{out}$	-	1	-	%/V	$V_S = 10\text{ V}$

### 3 Typical characteristics

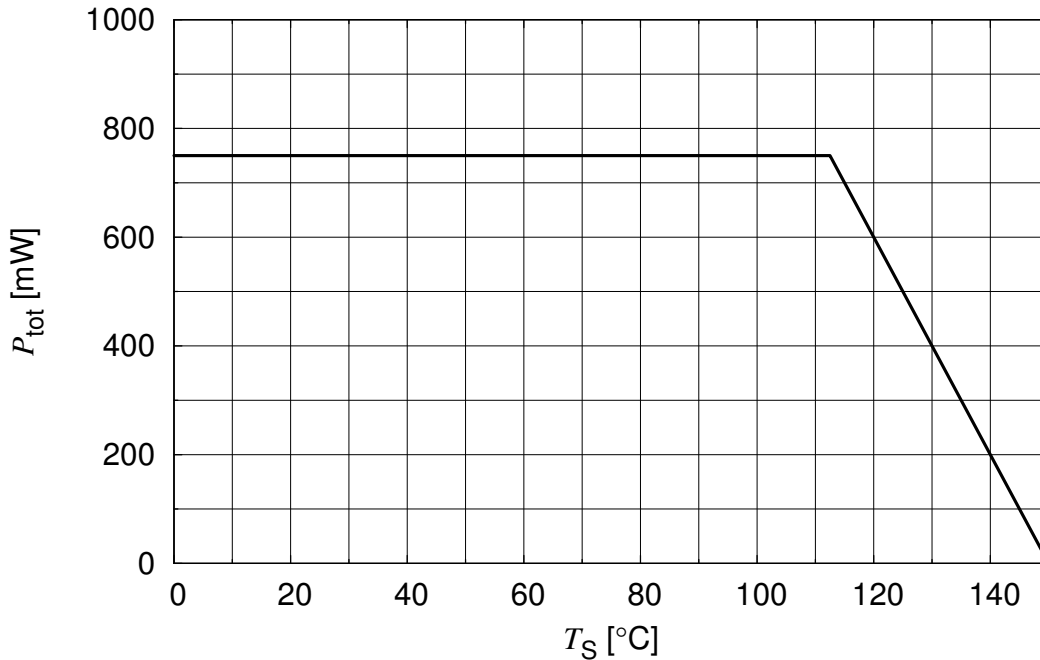


Figure 3-1 Total Power Dissipation  $P_{tot} = f(T_S)$

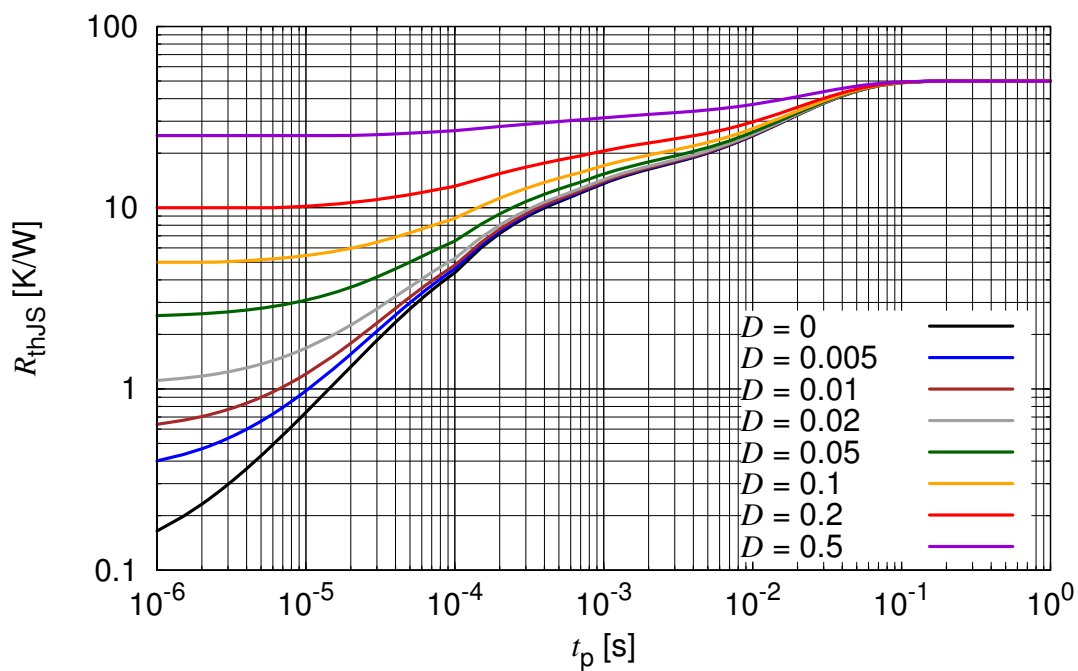
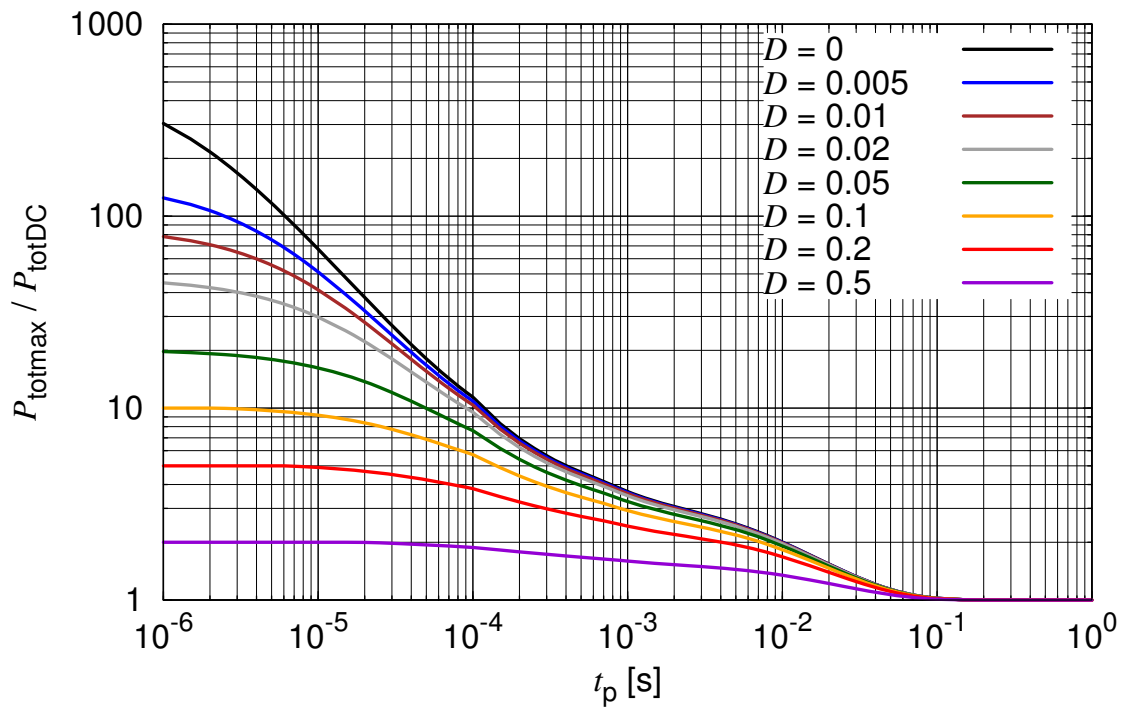
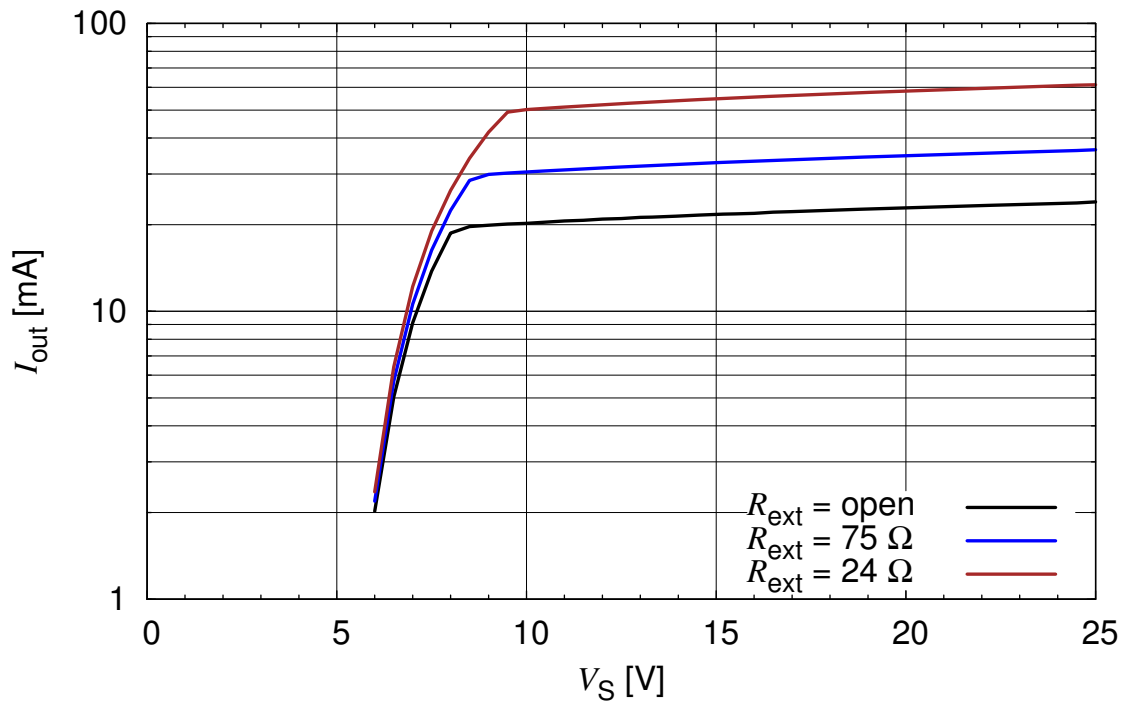


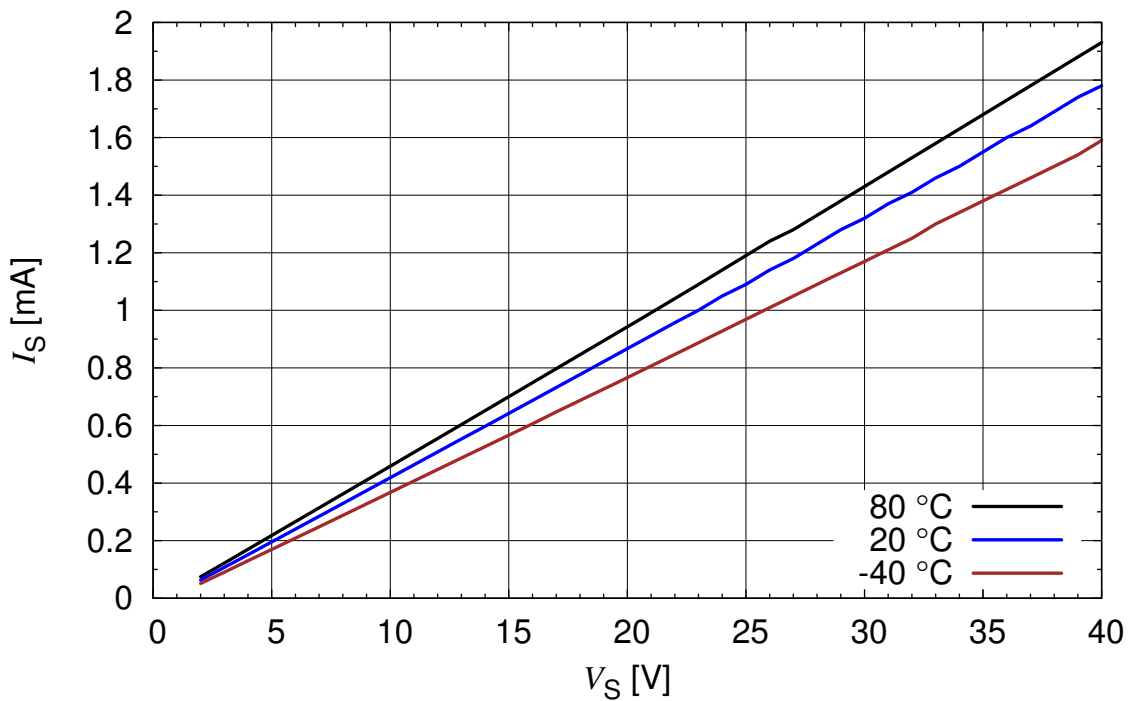
Figure 3-2 Permissible Pulse Load  $R_{thJS} = f(t_p)$



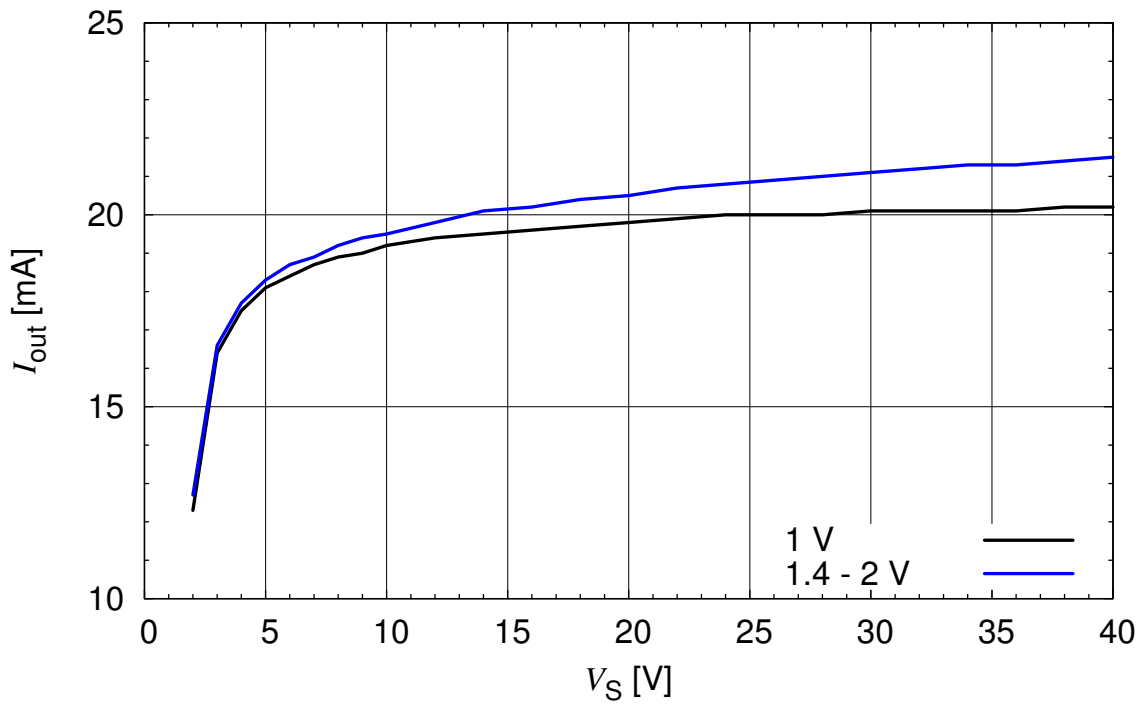
**Figure 3-3 Permissible Pulse Load  $P_{totmax} / P_{totDC} = f(t_p)$**



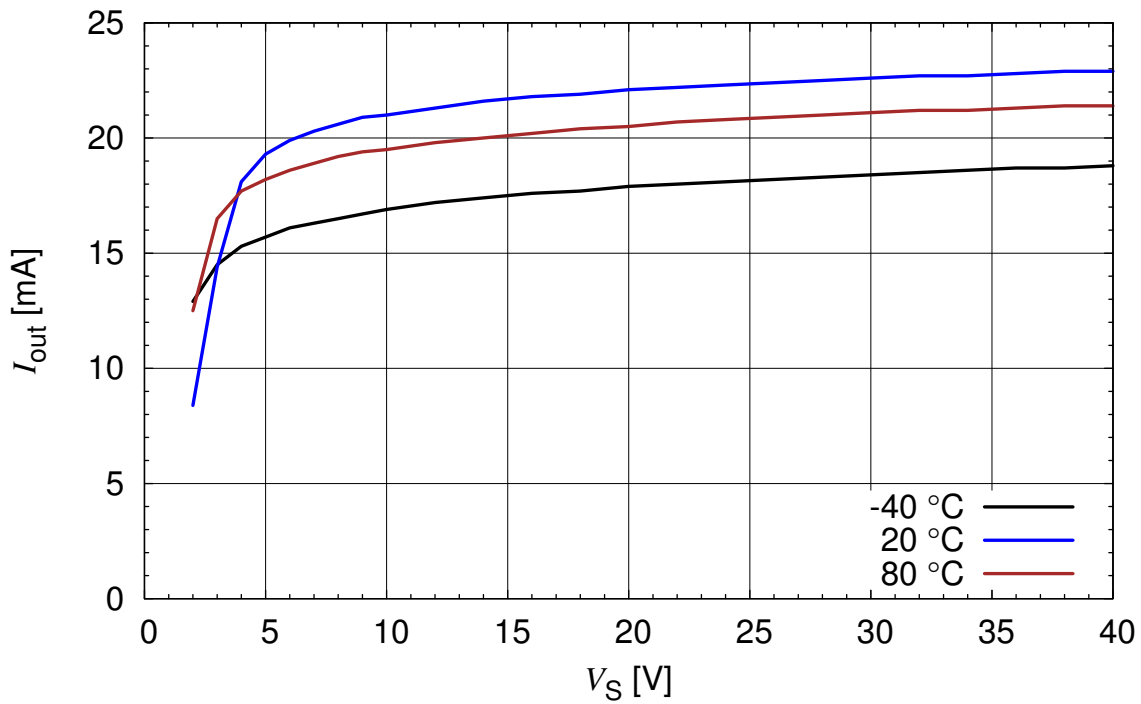
**Figure 3-4 Output Current versus  $V_S$   $I_{out} = f(V_S)$ ,  $V_S - V_{out} = 1.4$  V,  $R_{ext} =$  Parameter**



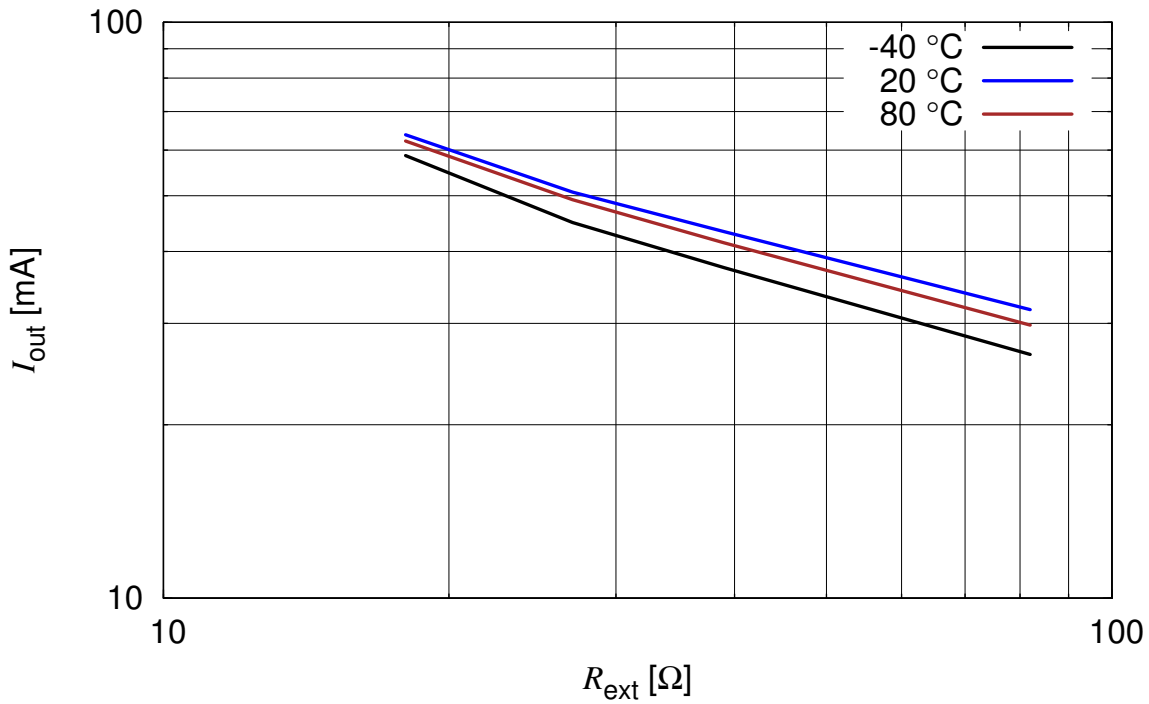
**Figure 3-5 Supply Current versus  $V_S$   $I_S = f(V_S)$ ,  $T_A =$  Parameter**



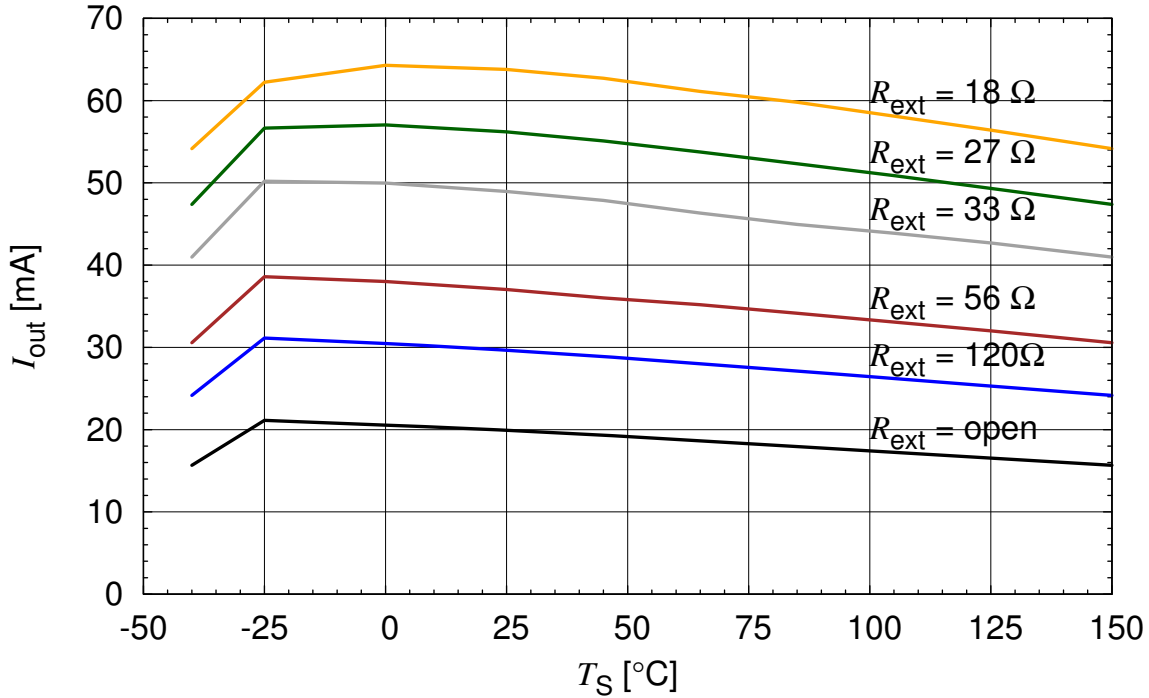
**Figure 3-6 Output Current versus  $V_S$**   $I_{out} = f(V_S)$ ,  $V_S - V_{out} = \text{Parameter}$



**Figure 3-7 Output Current versus  $V_S$**   $I_{out} = f(V_S)$ ,  $V_S - V_{out} = 1.4 \text{ V}$ ,  $T_A = \text{Parameter}$

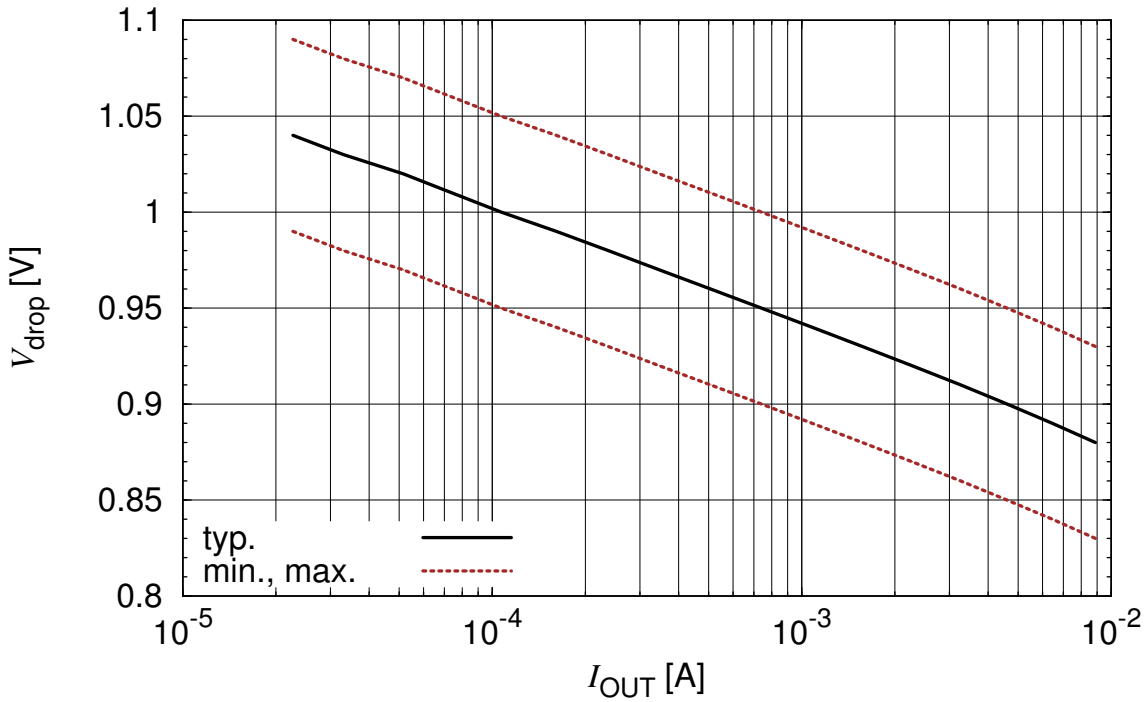


**Figure 3-8 Output Current versus  $R_{ext}$**   $I_{out} = f(R_{ext})$ ,  $V_S = 10\text{ V}$ ,  $V_S - V_{out} = 1.4\text{ V}$ ,  $T_A = \text{Parameter}$

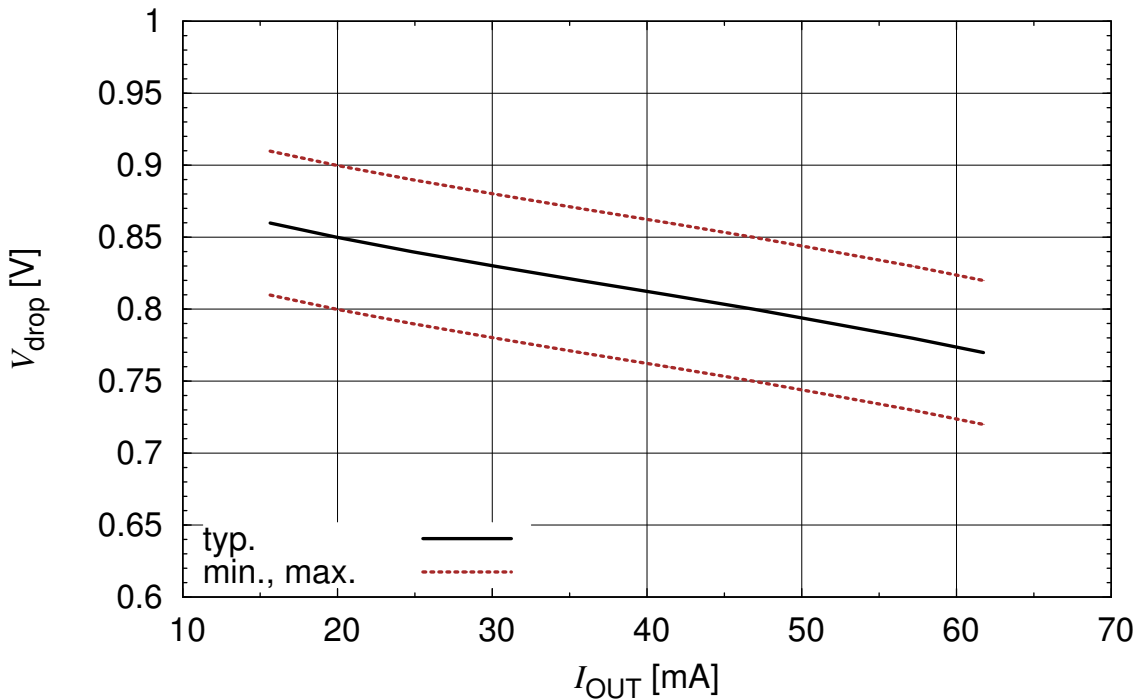


**Figure 3-9 Output Current versus  $T_S$**   $I_{out} = f(T_S)$ ,  $V_S = 10\text{ V}$ ,  $V_S - V_{out} = 1.4\text{ V}$ ,  $R_{ext} = \text{Parameter}$



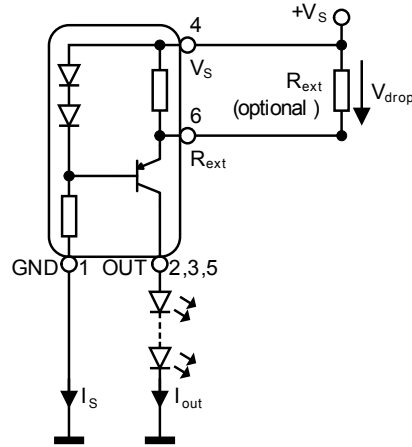


**Figure 3-10 Reference Voltage  $V_{drop}$  vs  $I_{out}$   $V_{drop} = f(I_{out})$ ,  $I_{out} = 10 \mu A$  to 10 mA**

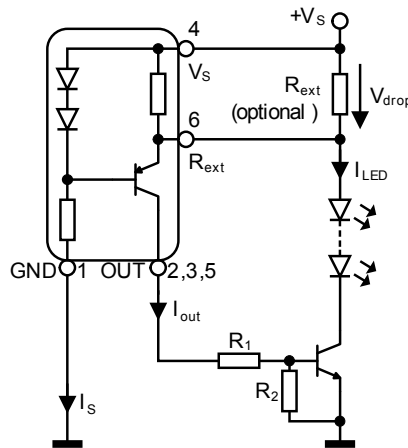


**Figure 3-11 Reference Voltage  $V_{drop}$  vs  $I_{out}$   $V_{drop} = f(I_{out})$ ,  $I_{out} = 10 mA$  to 65 mA**

## 4 Application hints



**Figure 4-1 Application Circuit: Stand alone current source**

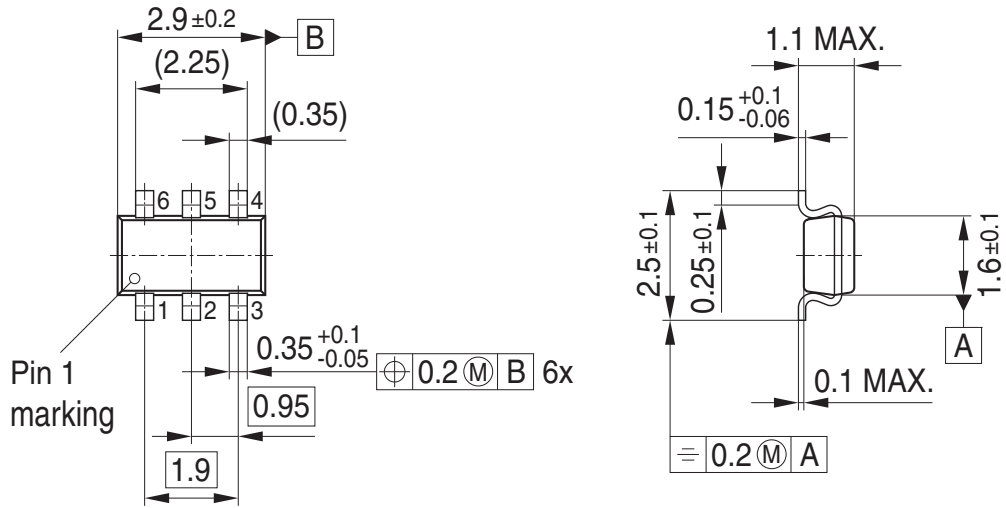


**Figure 4-2 Application Circuit: Boost mode current source with external power transistor**

### Application hints

XB402U serves as an easy to use constant current source for LEDs. In stand alone application an external resistor  $R_{ext}$  can be connected to adjust the current between 20 mA and 65 mA.  $R_{ext}$  can be determined by using **Figure 3-8**. Connecting a low tolerance resistor  $R_{ext}$  will improve the overall accuracy of the current sense resistance formed by the parallel connection of  $R_{int}$  and  $R_{ext}$  leading to an improved current accuracy. Please take into account that the resulting output currents will be slightly lower due to the self heating of the component and the negative thermal coefficient.

**5 SC74-6封装图**



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