

A large, light blue decorative graphic consisting of a thick curved line that forms a partial circle, with a small solid circle at its top end.

LED Driver

BCR402U

Datasheet

Revision 2.0, 2012-04-13

Power Management & Multimarket

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## Revision History

| Page or Item                    | Subjects (major changes since previous revision) |
|---------------------------------|--------------------------------------------------|
| <b>Revision 2.0, 2012-04-13</b> |                                                  |
| All                             | Datasheet layout updated                         |
| <b>Table 2-1</b>                | $V_{out}$ limit increased                        |
| <b>Table 2-3</b>                | $R_{int}$ limits tightened                       |
| <b>Figure 3-7</b>               | Temperature labels updated                       |
| <b>Figure 3-8</b>               | Temperature labels updated                       |

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## 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



SC74-3D



### 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 BCR402U 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 BCR402U 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 BCR402U 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.

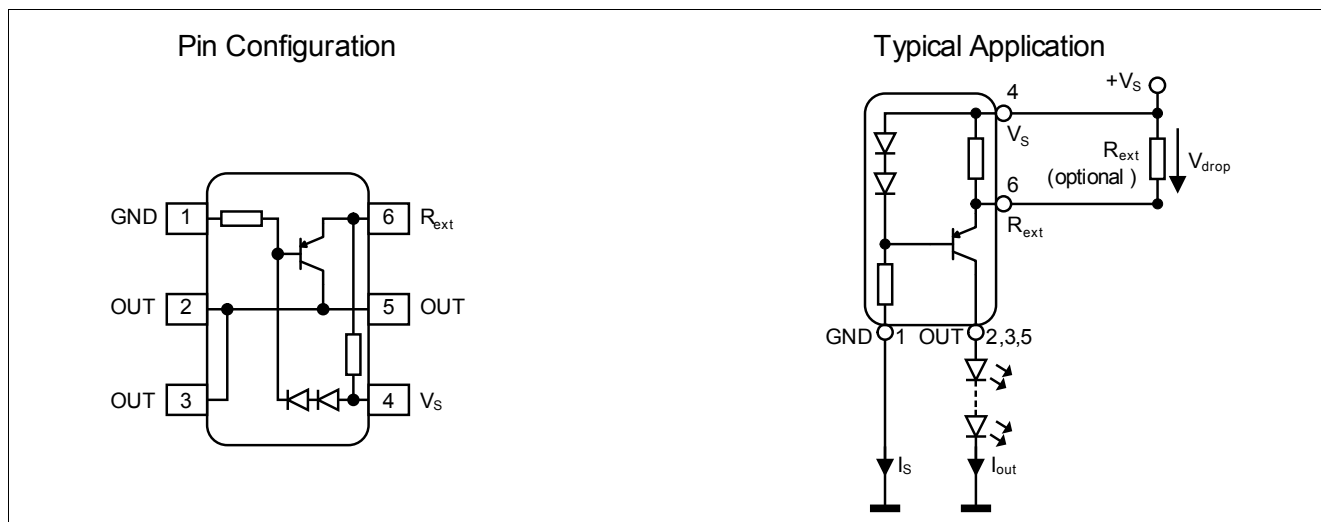


Figure 1-1 Pin configuration and typical application

| Type    | Marking | Pin Configuration |               |           |               | Package |
|---------|---------|-------------------|---------------|-----------|---------------|---------|
| BCR402U | L2s     | 1 = GND           | 2; 3; 5 = OUT | 4 = $V_S$ | 6 = $R_{ext}$ | SC74    |



## 2 Electrical Characteristics

**Table 2-1 Maximum Ratings at  $T_A = 25\text{ °C}$ , 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   | $T_S \leq 112.5\text{ °C}$ |
| Junction temperature                  | $T_J$     | -      | -    | 150  | °C   |                            |
| Storage temperature range             | $T_{STG}$ | -65    | -    | 150  | °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  $T_A = 25\text{ °C}$ , 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  $T_A = 25\text{ °C}$ , 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  | μA   | $V_S = 10\text{ V}$                             |
| 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   | Ω    | $I_{Rint} = 10\text{ mA}$                       |
| Output current                      | $I_{out}$     | 18     | 20   | 22   | mA   | $V_S = 10\text{ V}$<br>$V_{out} = 8.6\text{ V}$ |
| 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  $T_A = 25\text{ °C}$ , 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

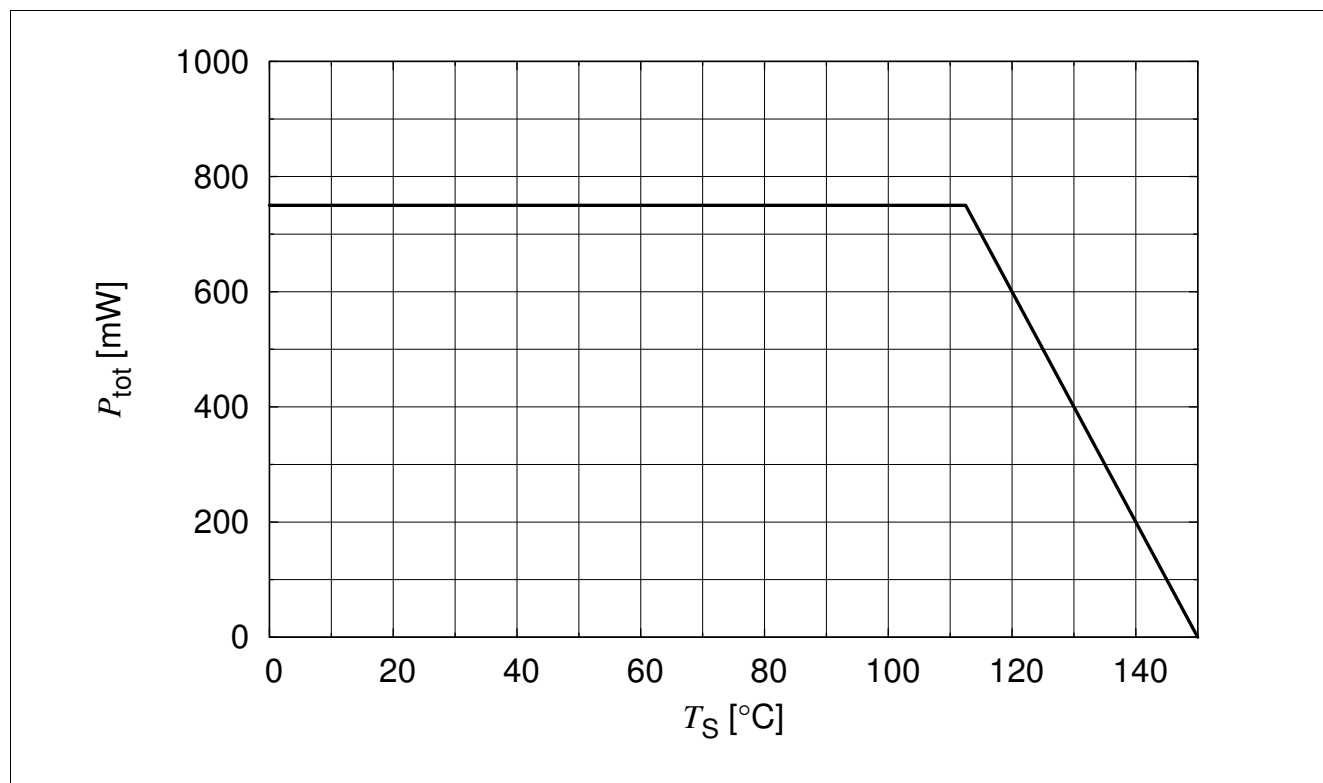


Figure 3-1 Total Power Dissipation  $P_{\text{tot}} = f(T_S)$

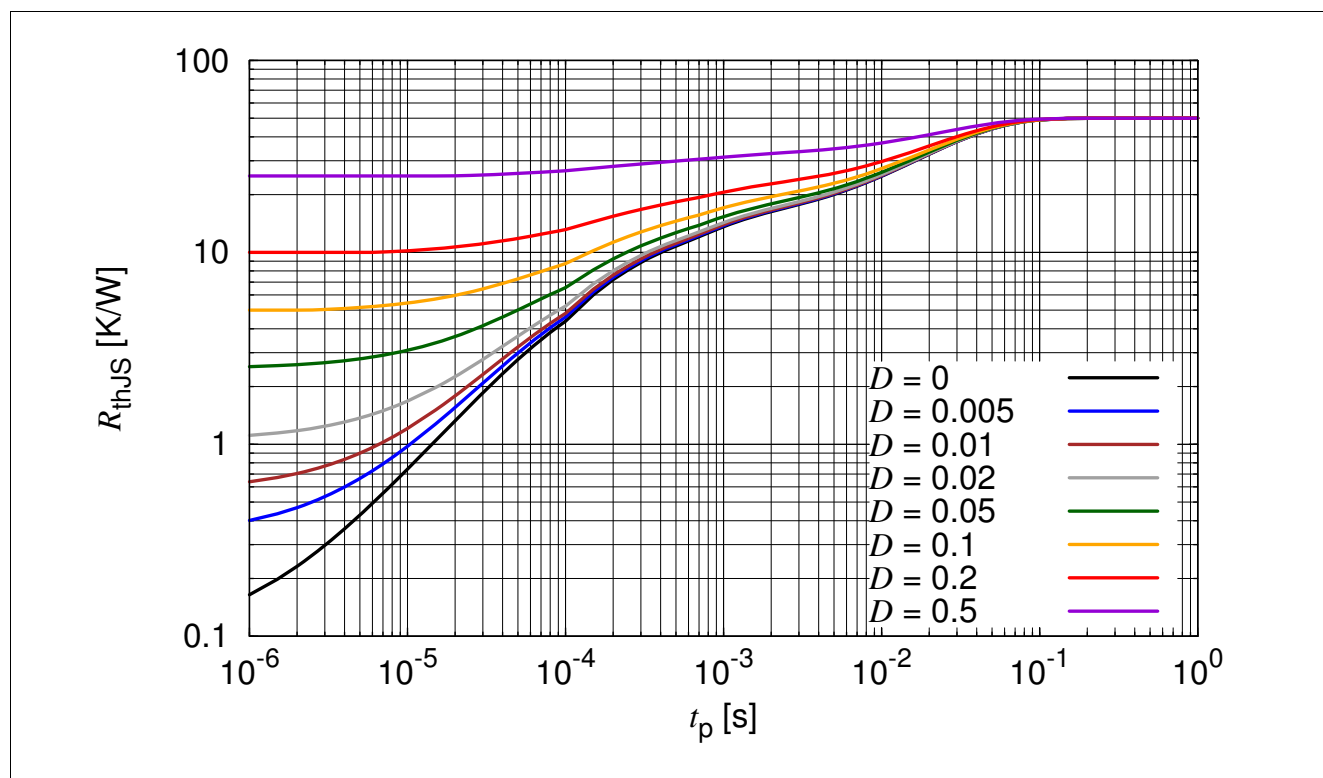


Figure 3-2 Permissible Pulse Load  $R_{\text{thJS}} = f(t_p)$

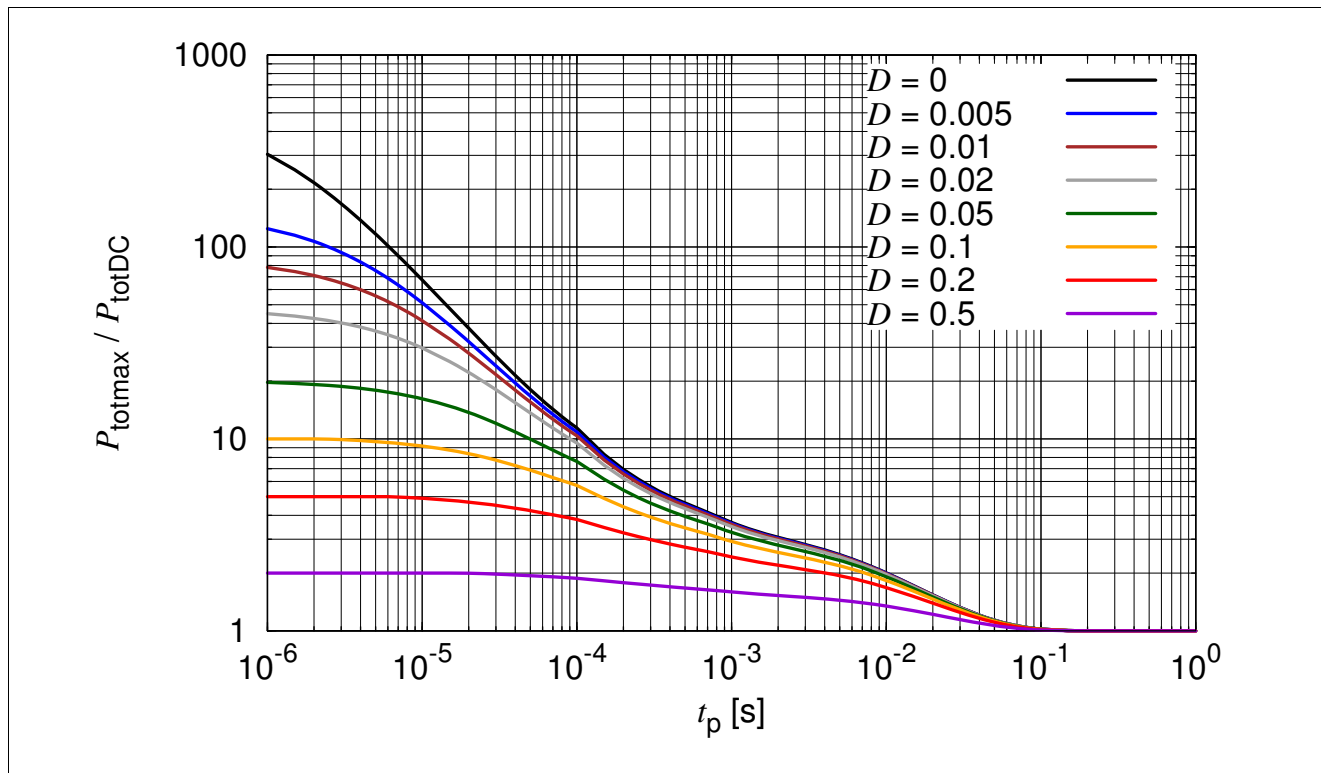


Figure 3-3 Permissible Pulse Load  $P_{\text{totmax}} / P_{\text{totDC}} = f(t_p)$

## Typical characteristics

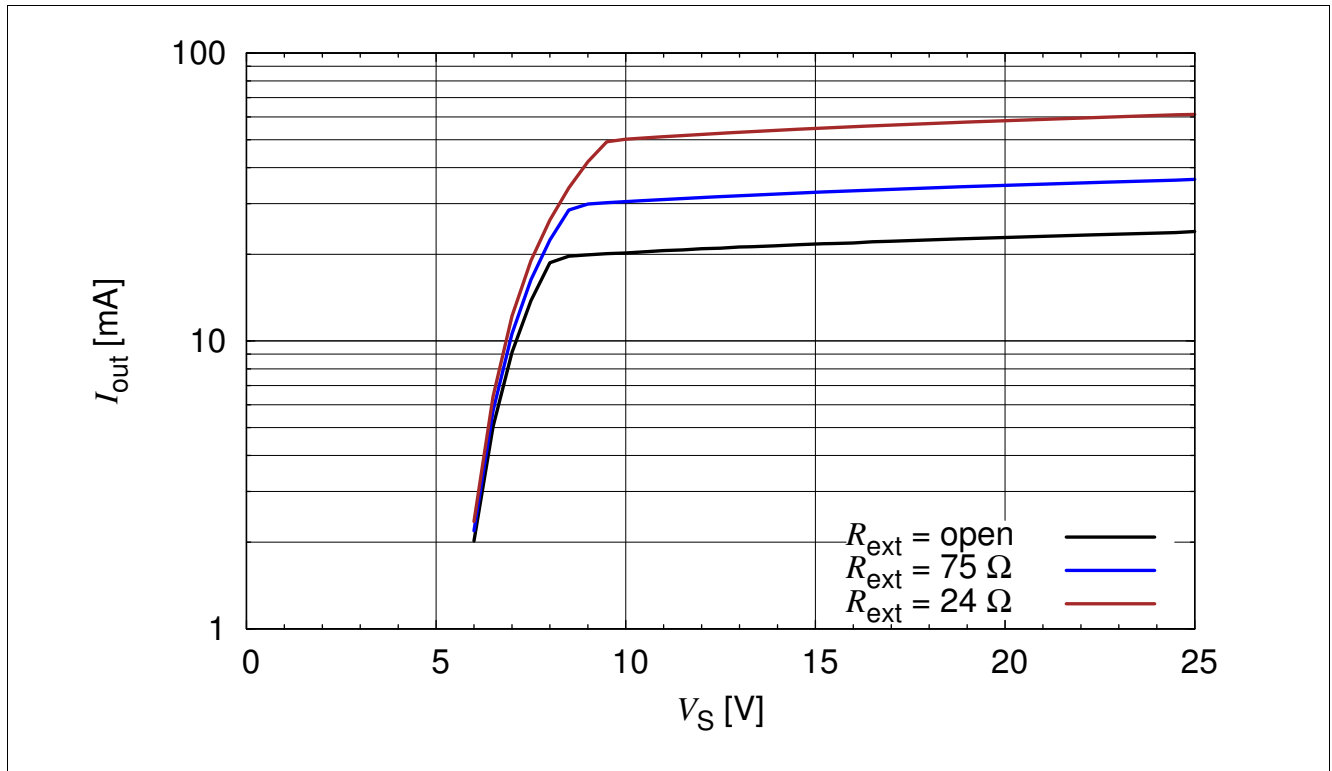


Figure 3-4 Output Current versus  $V_S$   $I_{out} = f(V_S)$ ,  $V_S - V_{out} = 1.4 \text{ V}$ ,  $R_{ext} = \text{Parameter}$

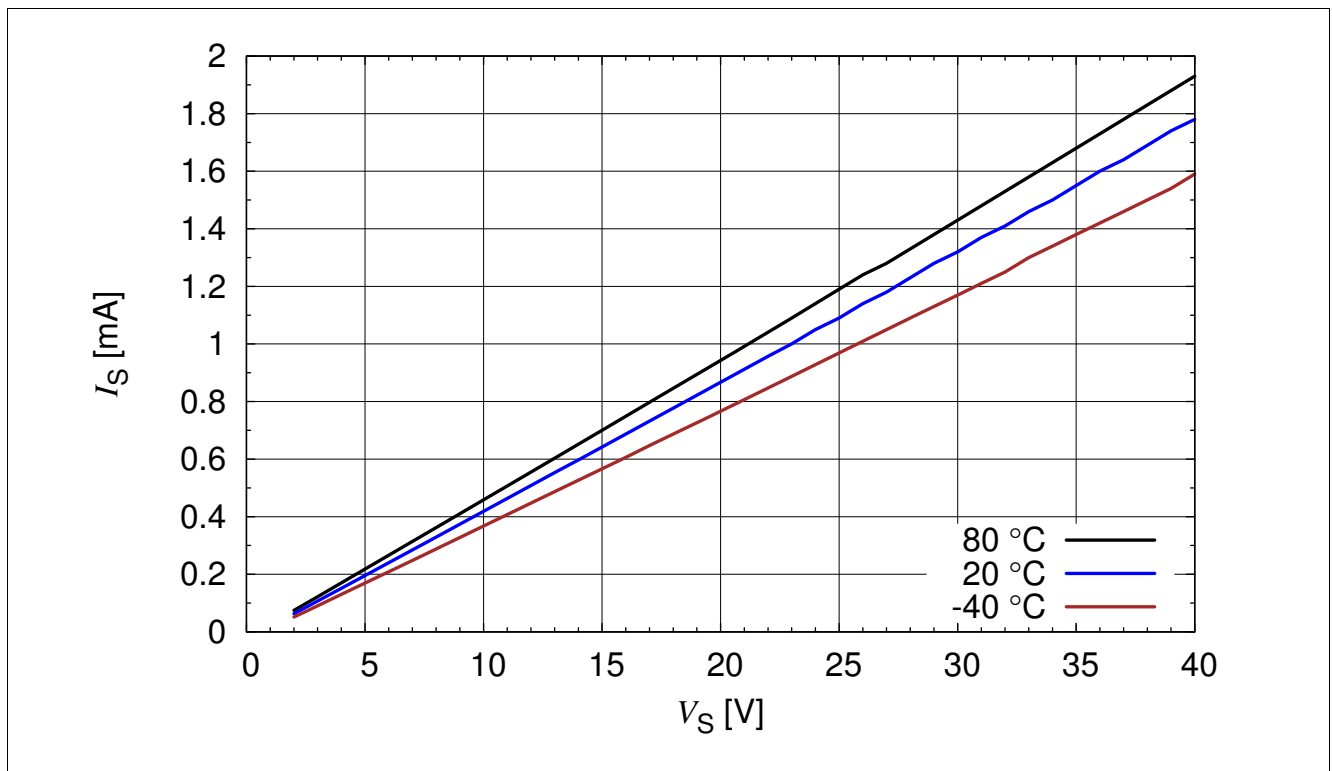


Figure 3-5 Supply Current versus  $V_S$   $I_S = f(V_S)$ ,  $T_A = \text{Parameter}$

## Typical characteristics

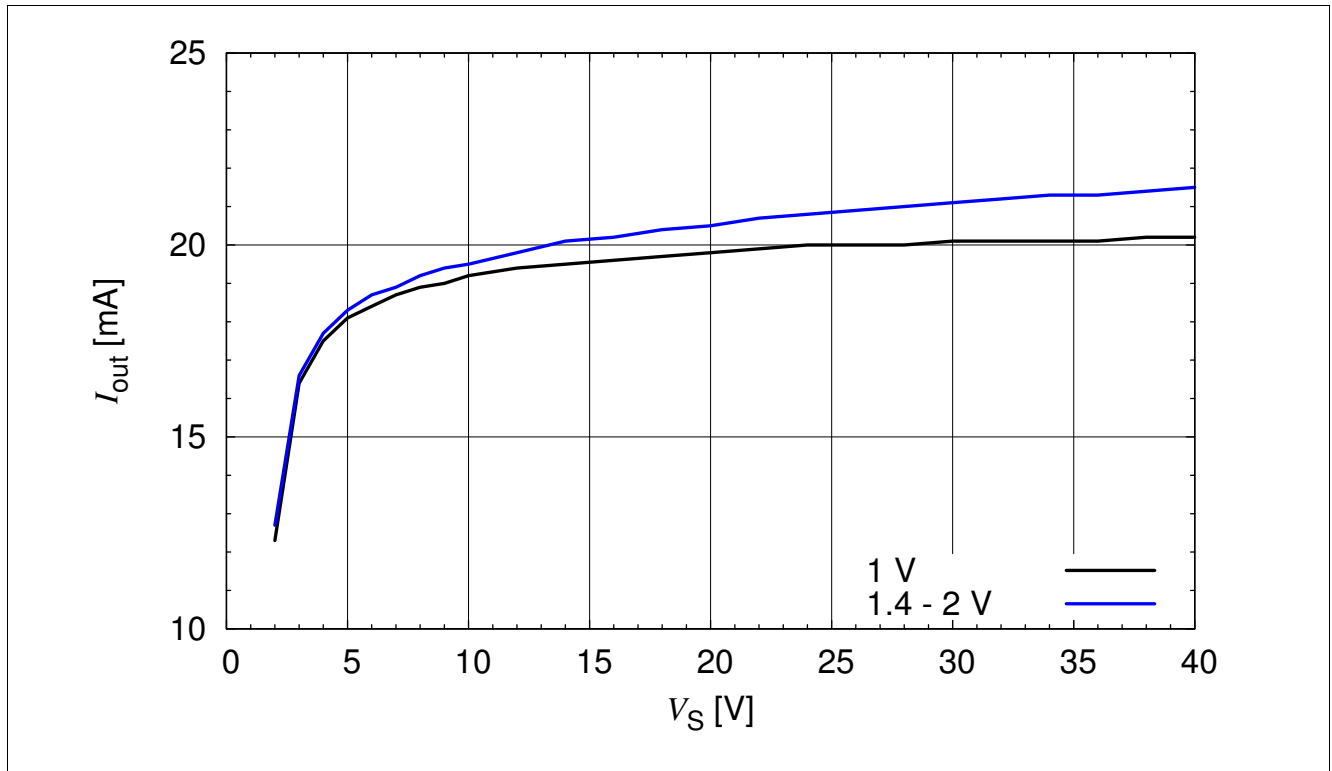


Figure 3-6 Output Current versus  $V_S$   $I_{out} = f(V_S)$ ,  $V_S - V_{out}$  = Parameter

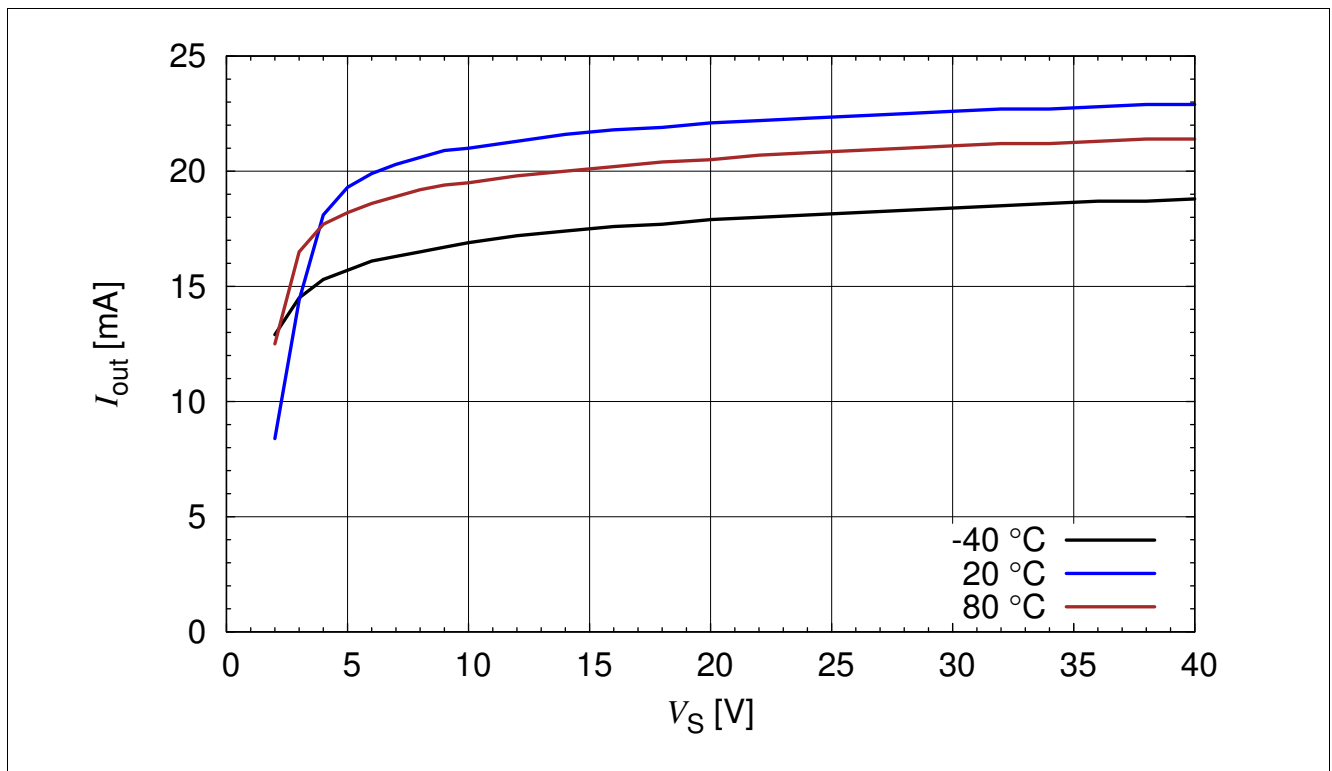
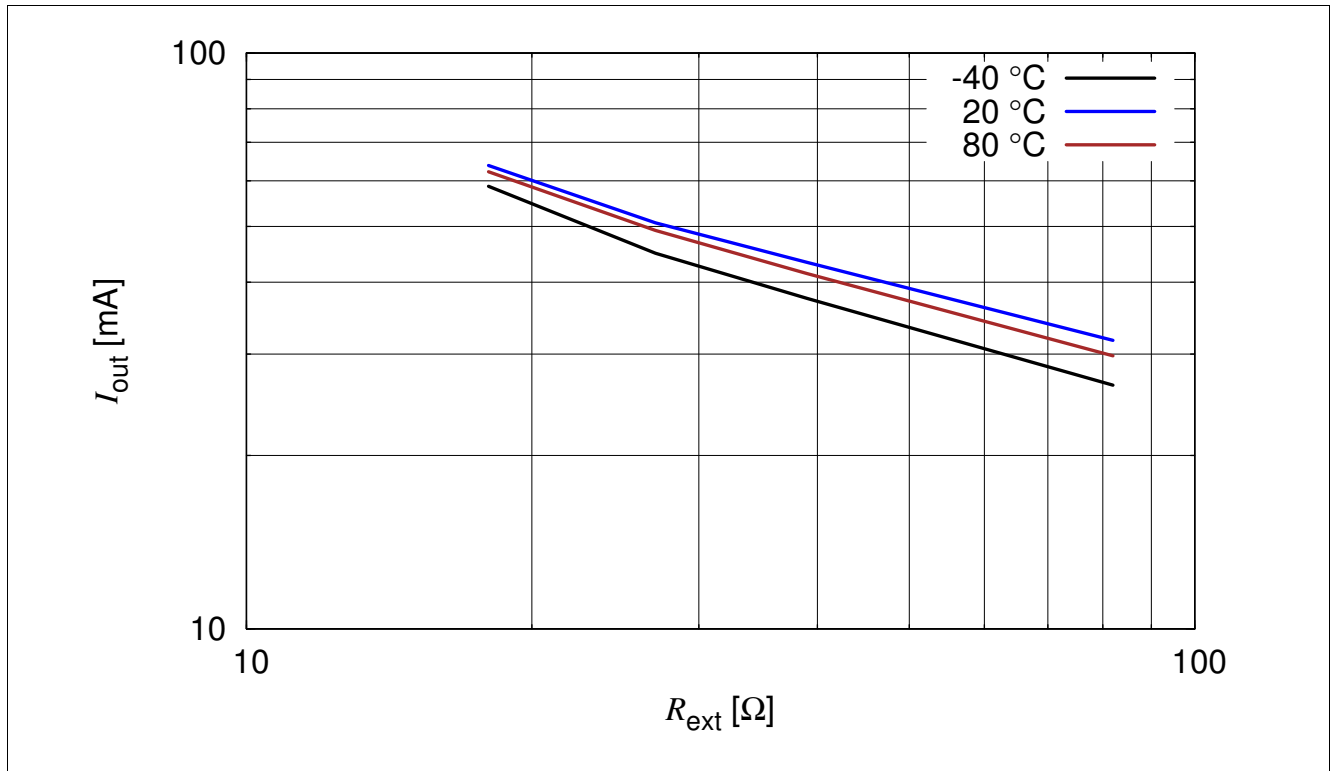
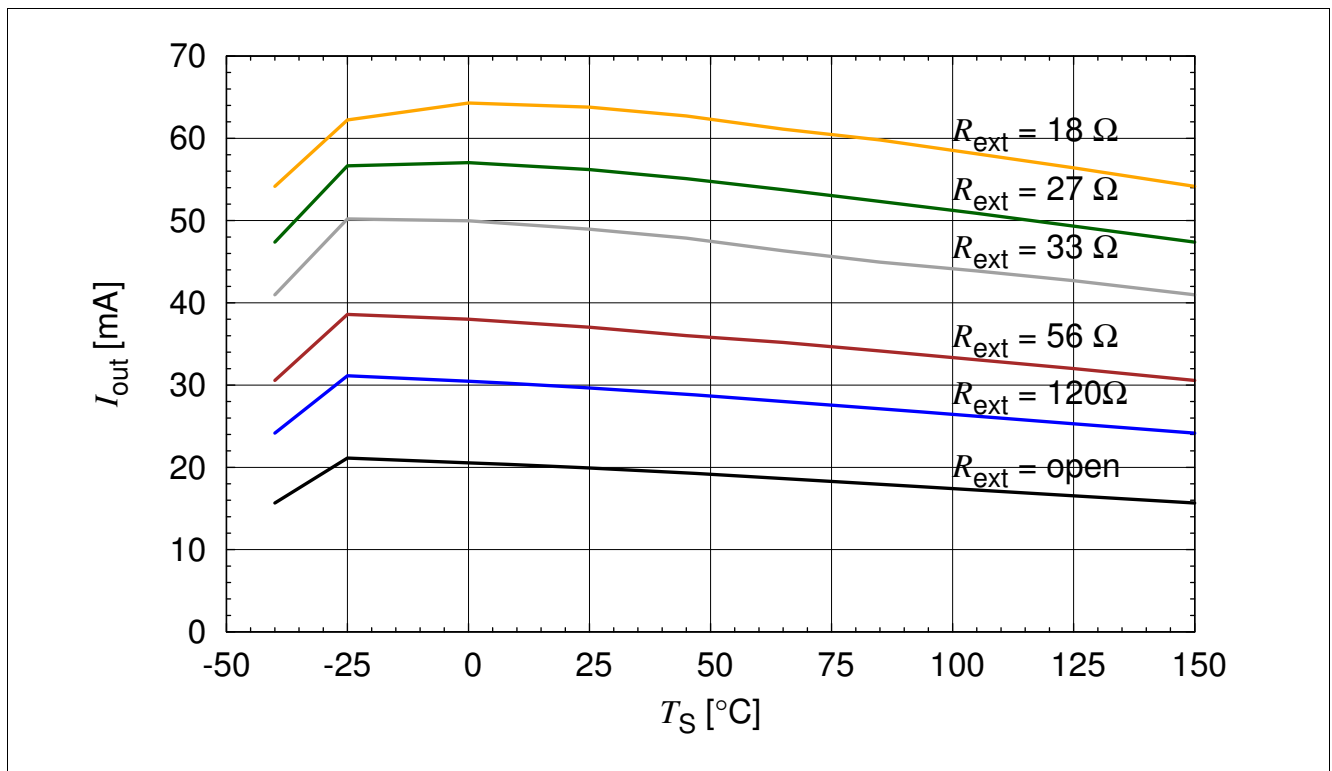


Figure 3-7 Output Current versus  $V_S$   $I_{out} = f(V_S)$ ,  $V_S - V_{out} = 1.4$  V,  $T_A$  = Parameter

## Typical characteristics



**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  $T_S$**   $I_{out} = f(T_S)$ ,  $V_S = 10\text{ V}$ ,  $V_S - V_{out} = 1.4\text{ V}$ ,  $R_{ext} = \text{Parameter}$

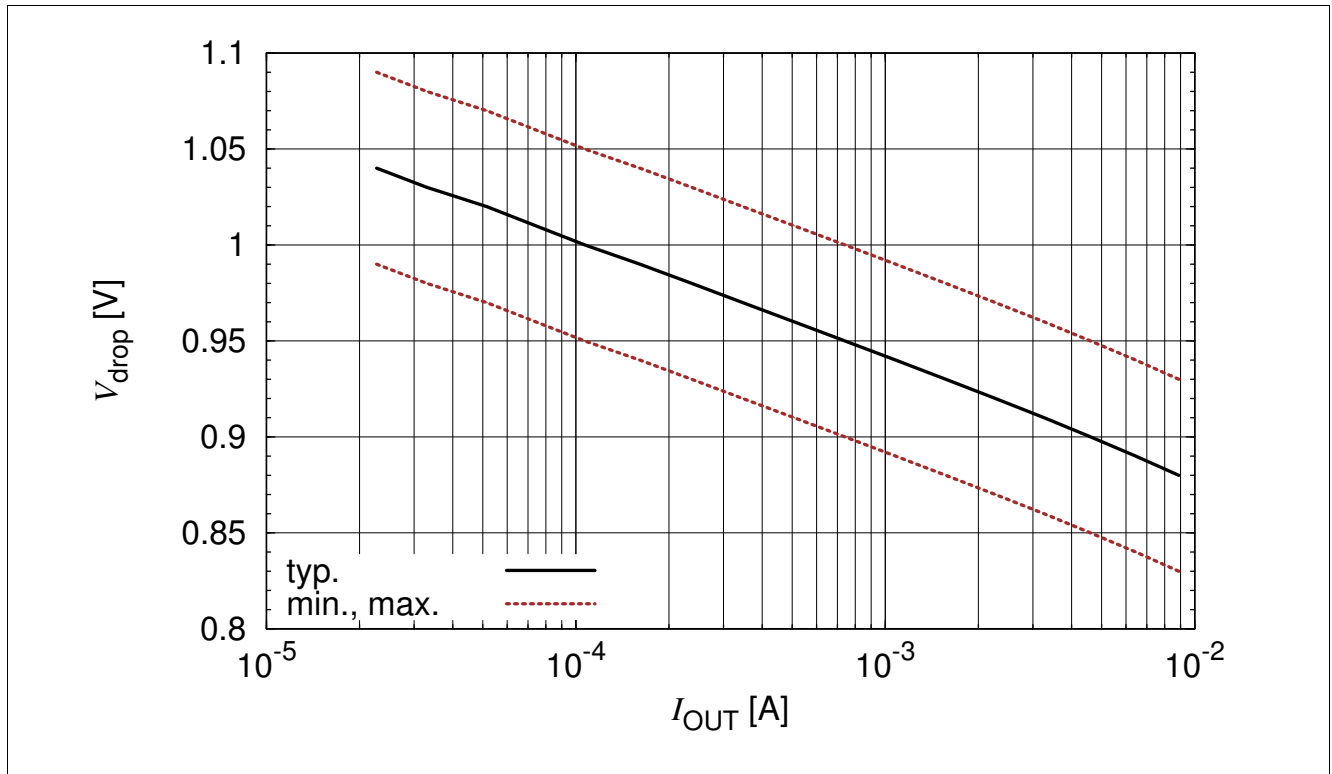


Figure 3-10 Reference Voltage  $V_{drop}$  vs  $I_{out}$   $V_{drop} = f(I_{out})$ ,  $I_{out} = 10 \mu A$  to 10 mA

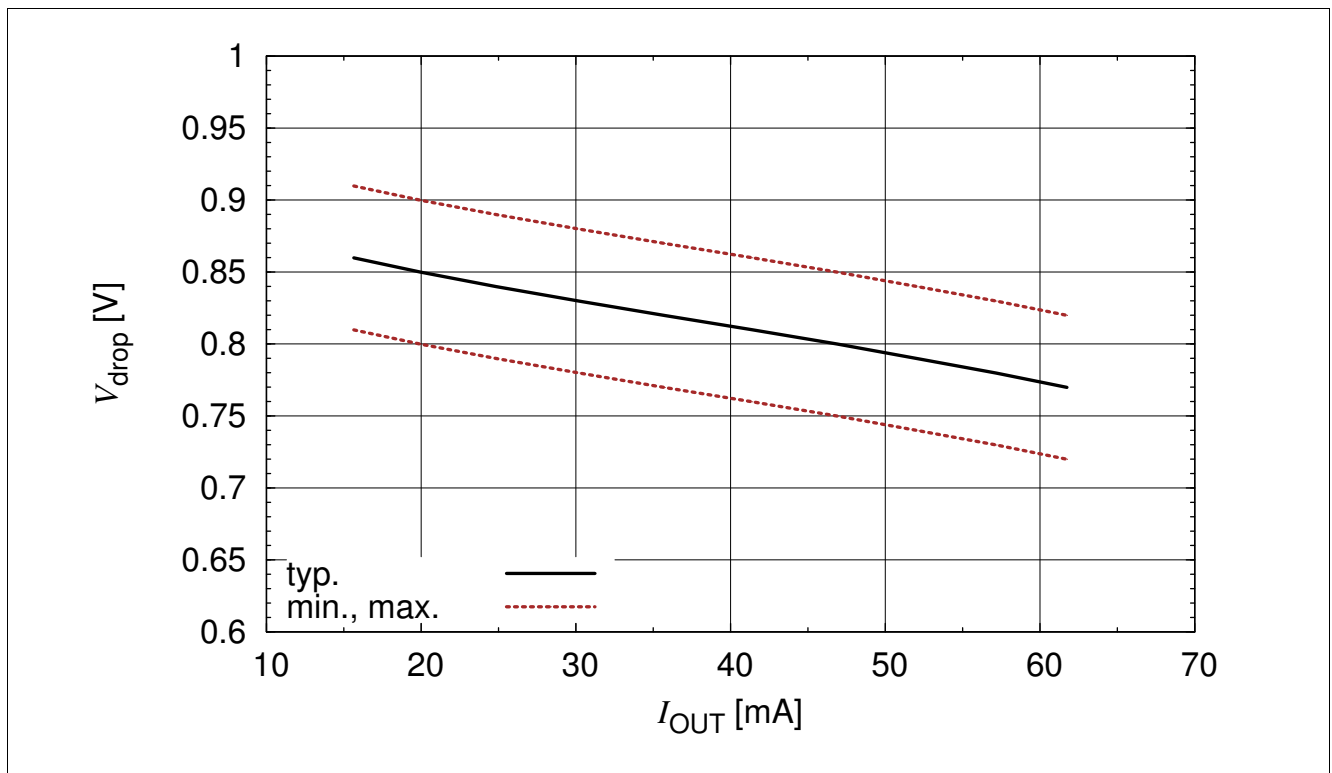


Figure 3-11 Reference Voltage  $V_{drop}$  vs  $I_{out}$   $V_{drop} = f(I_{out})$ ,  $I_{out} = 10 mA$  to 65 mA

## 4 Application hints

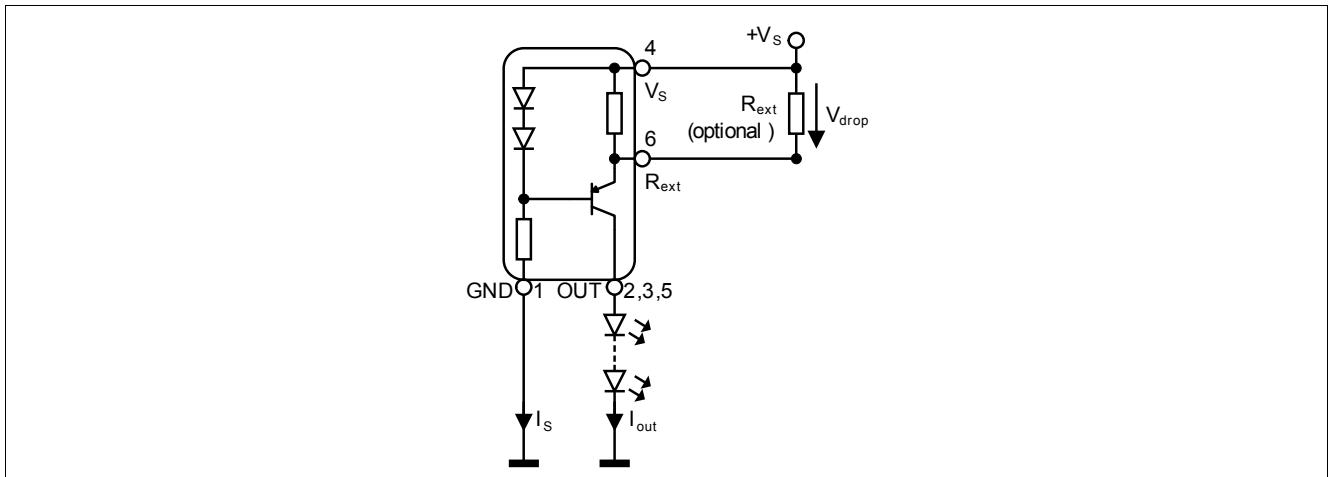


Figure 4-1 Application Circuit: Stand alone current source

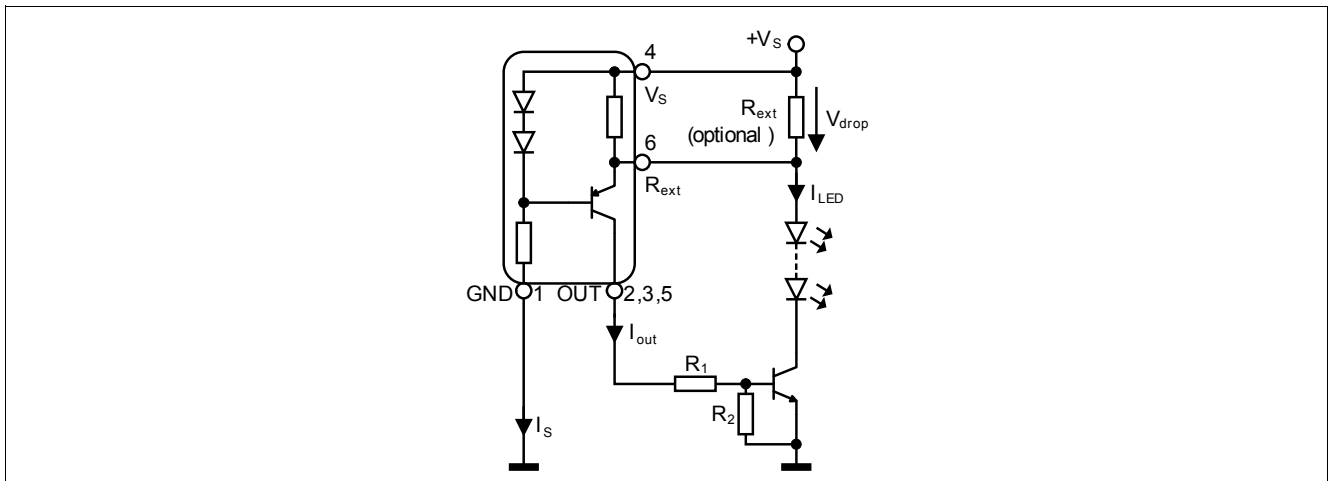


Figure 4-2 Application Circuit: Boost mode current source with external power transistor

### Application hints

BCR402U 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.

In boost mode configuration the LED current can be extended to drive high power LEDs. Please visit our web site [www.infineon.com/lowcostledriver](http://www.infineon.com/lowcostledriver) for detailed application notes.



## 5 Package

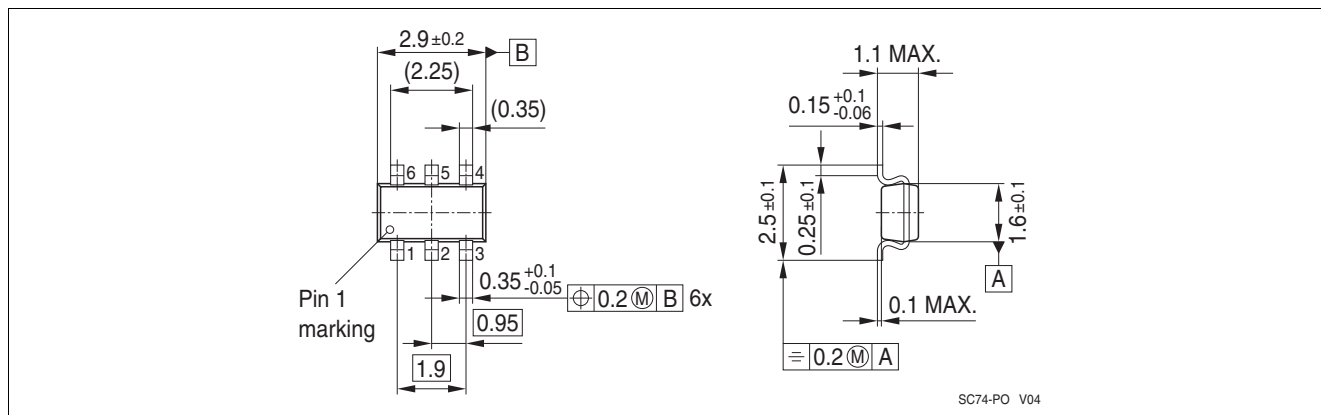


Figure 5-1 Package Outline for SC74 (dimensions in mm)

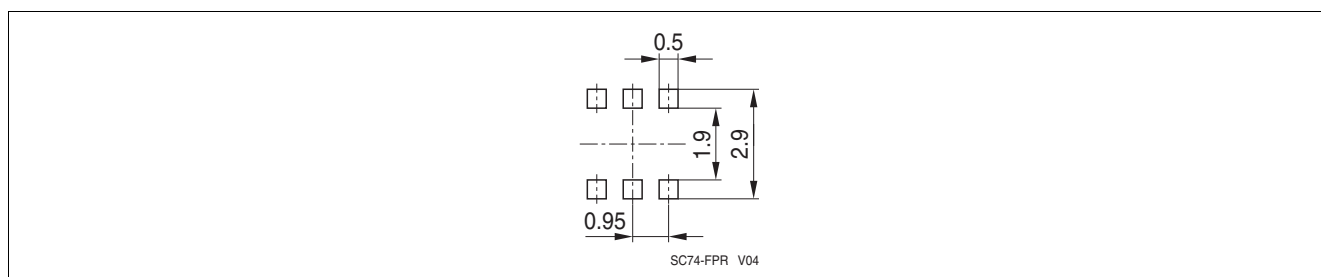


Figure 5-2 Package Footprint for SC74 (dimensions in mm)

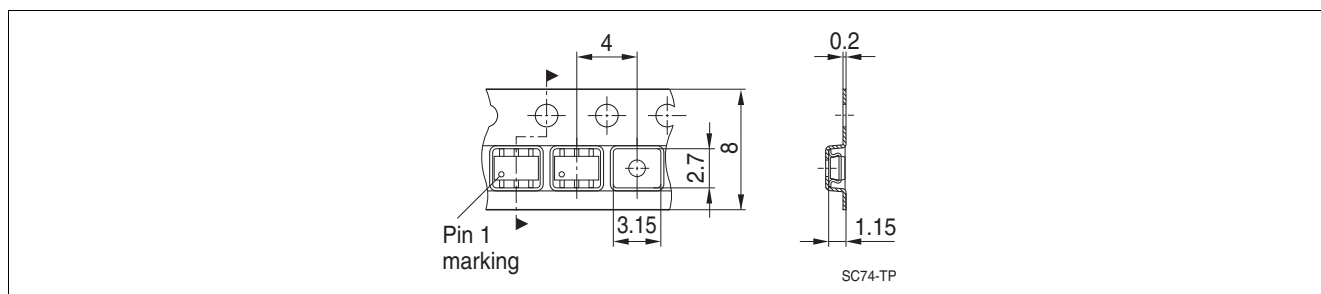


Figure 5-3 Tape and Reel Information for SC74 (dimensions in mm)

## Terminology

|                          |                                                |
|--------------------------|------------------------------------------------|
| $\Delta I_{out}/I_{out}$ | Output current change                          |
| $h_{FE}$                 | DC current gain                                |
| $I_{EN}$                 | Enable current                                 |
| $I_{LED}$                | LED current                                    |
| $I_{out}$                | Output current                                 |
| $I_R$                    | Reverse current                                |
| LED                      | Light Emitting Diode                           |
| PCB                      | Printed Circuit Board                          |
| $P_{tot}$                | Total power dissipation                        |
| PWM                      | Pulse Width Modulation                         |
| $R_B$                    | Bias resistor                                  |
| $R_{ext}$                | External resistor                              |
| $R_{int}$                | Internal resistor                              |
| RoHs                     | Restriction of Hazardous Substance directive   |
| $R_{thJS}$               | Thermal resistance junction to soldering point |
| $T_A$                    | Ambient temperature                            |
| $T_J$                    | Junction temperature                           |
| $T_S$                    | Soldering point temperature                    |
| $T_{stg}$                | Storage temperature                            |
| $V_{BR(CEO)}$            | Collector-emitter breakdown voltage            |
| $V_{BR}$                 | Breakdown voltage                              |
| $V_{drop}$               | Voltage drop                                   |
| $V_{EN}$                 | Enable voltage                                 |
| $V_{out}$                | Output voltage                                 |
| $V_R$                    | Reverse voltage                                |
| $V_S$                    | Supply voltage                                 |
| $V_{Smin}$               | Lowest sufficient supply voltage overhead      |

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