

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

LED Driver

BCR402U

Datasheet

Revision 2.0, 2012-04-13

Power Management & Multimarket

**Edition 2012-04-13**

**Published by  
Infineon Technologies AG  
81726 Munich, Germany**

**© 2012 Infineon Technologies AG  
All Rights Reserved.**

### **Legal Disclaimer**

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics. With respect to any examples or hints given herein, any typical values stated herein and/or any information regarding the application of the device, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation, warranties of non-infringement of intellectual property rights of any third party.

### **Information**

For further information on technology, delivery terms and conditions and prices, please contact the nearest Infineon Technologies Office ([www.infineon.com](http://www.infineon.com)).

### **Warnings**

Due to technical requirements, components may contain dangerous substances. For information on the types in question, please contact the nearest Infineon Technologies Office.

Infineon Technologies components may be used in life-support devices or systems only with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support device or system or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.

**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

**Trademarks of Infineon Technologies AG**

AURIX™, C166™, CanPAK™, CIPOS™, CIPURSE™, EconoPACK™, CoolMOS™, CoolSET™, CORECONTROL™, CROSSAVE™, DAVE™, DI-POL™, EasyPIM™, EconoBRIDGE™, EconoDUAL™, EconoPIM™, EconoPACK™, EiceDRIVER™, eupec™, FCOS™, HITFET™, HybridPACK™, I<sup>2</sup>RF™, ISOFACE™, IsoPACK™, MIPAQ™, ModSTACK™, my-d™, NovalithIC™, OptiMOS™, ORIGA™, POWERCODE™, PRIMARION™, PrimePACK™, PrimeSTACK™, PRO-SIL™, PROFET™, RASIC™, ReverSave™, SatRIC™, SIEGET™, SINDRION™, SIPMOS™, SmartLEWIS™, SOLID FLASH™, TEMPFET™, thinQ!™, TRENCHSTOP™, TriCore™.

**Other Trademarks**

Advance Design System™ (ADS) of Agilent Technologies, AMBA™, ARM™, MULTI-ICE™, KEIL™, PRIMECELL™, REALVIEW™, THUMB™, μVision™ of ARM Limited, UK. AUTOSAR™ is licensed by AUTOSAR development partnership. Bluetooth™ of Bluetooth SIG Inc. CAT-iq™ of DECT Forum. COLOSSUS™, FirstGPS™ of Trimble Navigation Ltd. EMV™ of EMVCo, LLC (Visa Holdings Inc.). EPCOS™ of Epcos AG. FLEXGO™ of Microsoft Corporation. FlexRay™ is licensed by FlexRay Consortium. HYPERTERMINAL™ of Hilgraeve Incorporated. IEC™ of Commission Electrotechnique Internationale. IrDA™ of Infrared Data Association Corporation. ISO™ of INTERNATIONAL ORGANIZATION FOR STANDARDIZATION. MATLAB™ of MathWorks, Inc. MAXIM™ of Maxim Integrated Products, Inc. MICROTEC™, NUCLEUS™ of Mentor Graphics Corporation. MIPI™ of MIPI Alliance, Inc. MIPS™ of MIPS Technologies, Inc., USA. muRata™ of MURATA MANUFACTURING CO., MICROWAVE OFFICE™ (MWO) of Applied Wave Research Inc., OmniVision™ of OmniVision Technologies, Inc. Openwave™ Openwave Systems Inc. RED HAT™ Red Hat, Inc. RFMD™ RF Micro Devices, Inc. SIRIUS™ of Sirius Satellite Radio Inc. SOLARIS™ of Sun Microsystems, Inc. SPANSION™ of Spansion LLC Ltd. Symbian™ of Symbian Software Limited. TAIYO YUDEN™ of Taiyo Yuden Co. TEAKLITE™ of CEVA, Inc. TEKTRONIX™ of Tektronix Inc. TOKO™ of TOKO KABUSHIKI KAISHA TA. UNIX™ of X/Open Company Limited. VERILOG™, PALLADIUM™ of Cadence Design Systems, Inc. VLYNQ™ of Texas Instruments Incorporated. VXWORKS™, WIND RIVER™ of WIND RIVER SYSTEMS, INC. ZETEX™ of Diodes Zetex Limited.

Last Trademarks Update 2011-11-11

## Table of Contents

	<b>Table of Contents</b> .....	4
	<b>List of Figures</b> .....	5
	<b>List of Tables</b> .....	6
<b>1</b>	<b>LED Driver</b> .....	7
1.1	Features .....	7
1.2	Applications .....	7
1.3	General Description .....	7
<b>2</b>	<b>Electrical Characteristics</b> .....	9
<b>3</b>	<b>Typical characteristics</b> .....	10
<b>4</b>	<b>Application hints</b> .....	16
<b>5</b>	<b>Package</b> .....	17
	<b>Terminology</b> .....	18

## List of Figures

Figure 1-1	Pin configuration and typical application. . . . .	8
Figure 3-1	Total Power Dissipation $P_{tot} = f(T_S)$ . . . . .	10
Figure 3-2	Permissible Pulse Load $R_{thJS} = f(t_p)$ . . . . .	10
Figure 3-3	Permissible Pulse Load $P_{totmax} / P_{totDC} = f(t_p)$ . . . . .	11
Figure 3-4	Output Current versus $V_S I_{out} = f(V_S)$ , $V_S - V_{out} = 1.4 V$ , $R_{ext} = \text{Parameter}$ . . . . .	12
Figure 3-5	Supply Current versus $V_S I_S = f(V_S)$ , $T_A = \text{Parameter}$ . . . . .	12
Figure 3-6	Output Current versus $V_S I_{out} = f(V_S)$ , $V_S - V_{out} = \text{Parameter}$ . . . . .	13
Figure 3-7	Output Current versus $V_S I_{out} = f(V_S)$ , $V_S - V_{out} = 1.4 V$ , $T_A = \text{Parameter}$ . . . . .	13
Figure 3-8	Output Current versus $R_{ext} I_{out} = f(R_{ext})$ , $V_S = 10 V$ , $V_S - V_{out} = 1.4 V$ , $T_A = \text{Parameter}$ . . . . .	14
Figure 3-9	Output Current versus $T_S I_{out} = f(T_S)$ , $V_S = 10 V$ , $V_S - V_{out} = 1.4 V$ , $R_{ext} = \text{Parameter}$ . . . . .	14
Figure 3-10	Reference Voltage $V_{drop}$ vs $I_{out}$ $V_{drop} = f(I_{out})$ , $I_{out} = 10 \mu A$ to $10 mA$ . . . . .	15
Figure 3-11	Reference Voltage $V_{drop}$ vs $I_{out}$ $V_{drop} = f(I_{out})$ , $I_{out} = 10 mA$ to $65 mA$ . . . . .	15
Figure 4-1	Application Circuit: Stand alone current source . . . . .	16
Figure 4-2	Application Circuit: Boost mode current source with external power transistor . . . . .	16
Figure 5-1	Package Outline for SC74 (dimensions in mm) . . . . .	17
Figure 5-2	Package Footprint for SC74 (dimensions in mm) . . . . .	17
Figure 5-3	Tape and Reel Information for SC74 (dimensions in mm) . . . . .	17

## List of Tables

Table 2-1	Maximum Ratings at $T_A = 25\text{ °C}$ , unless otherwise specified . . . . .	9
Table 2-2	Thermal Resistance at $T_A = 25\text{ °C}$ , unless otherwise specified . . . . .	9
Table 2-3	Electrical Characteristics at $T_A = 25\text{ °C}$ , unless otherwise specified . . . . .	9
Table 2-4	DC Characteristics with stabilized LED load at $T_A = 25\text{ °C}$ , unless otherwise specified . . . . .	9

## 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.

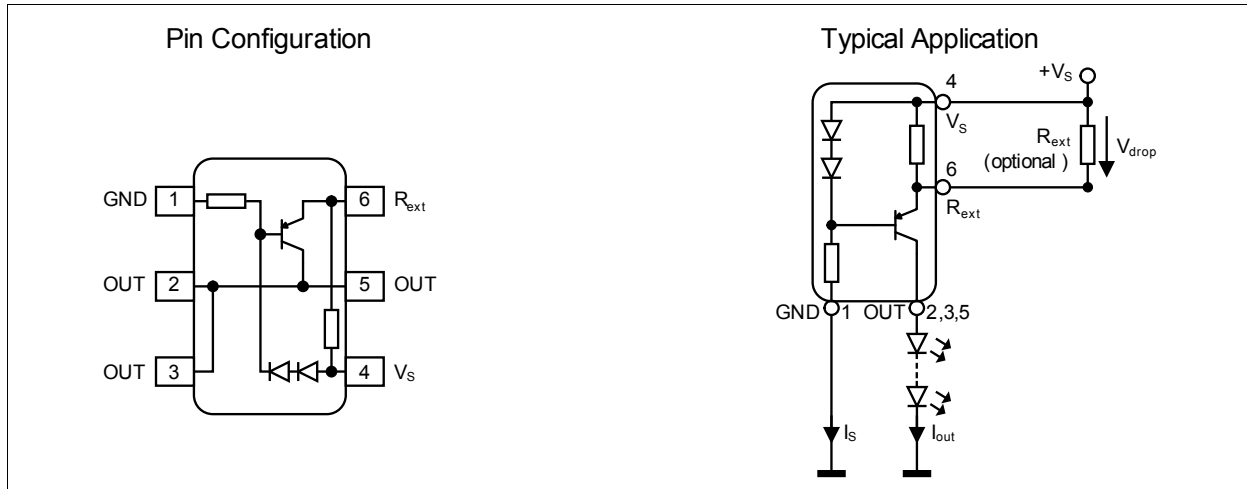


Figure 1-1 Pin configuration and typical application

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	$V_S = 10\text{ V}$ $V_{out} = 8.6\text{ V}$
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

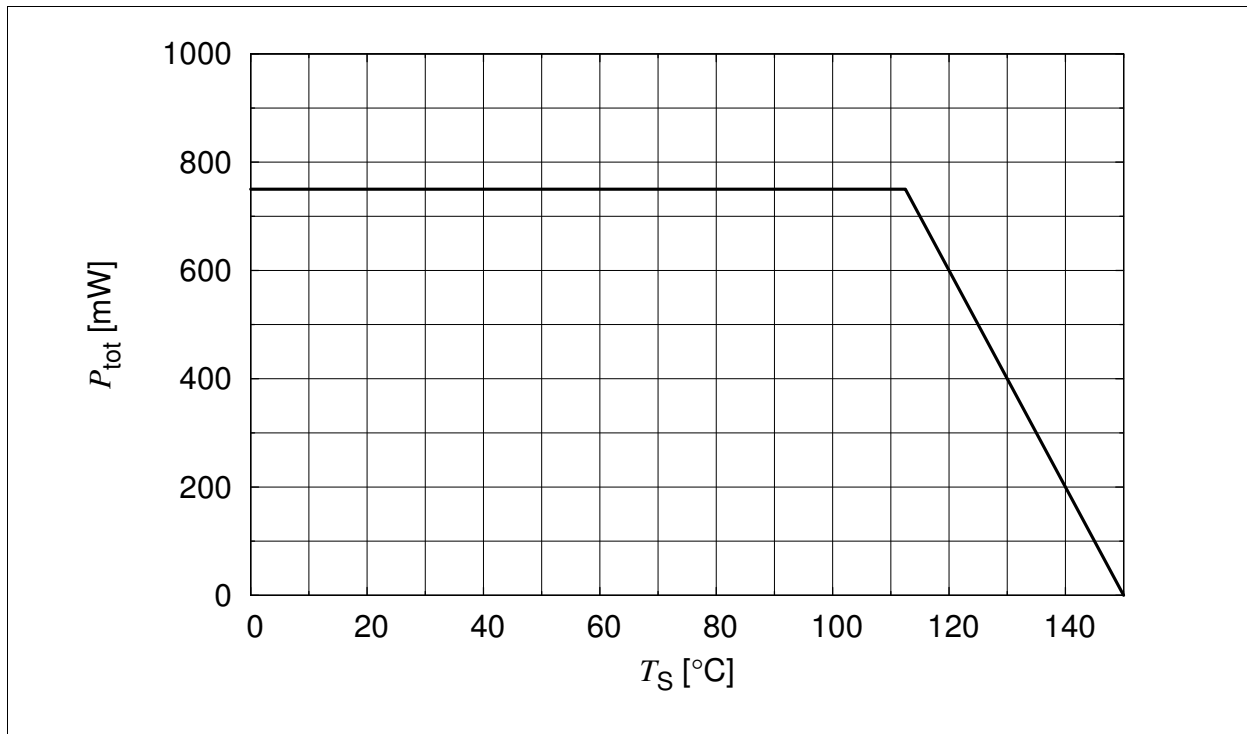


Figure 3-1 Total Power Dissipation  $P_{tot} = f(T_S)$

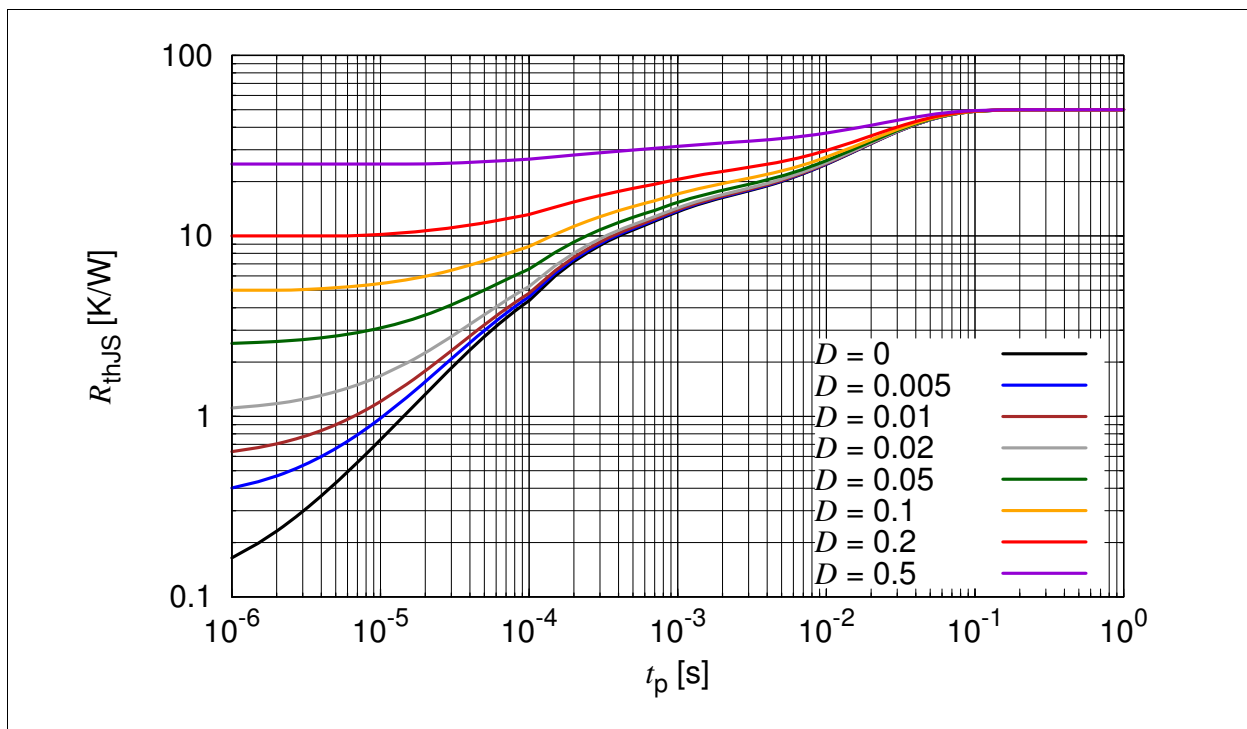


Figure 3-2 Permissible Pulse Load  $R_{thJS} = f(t_p)$

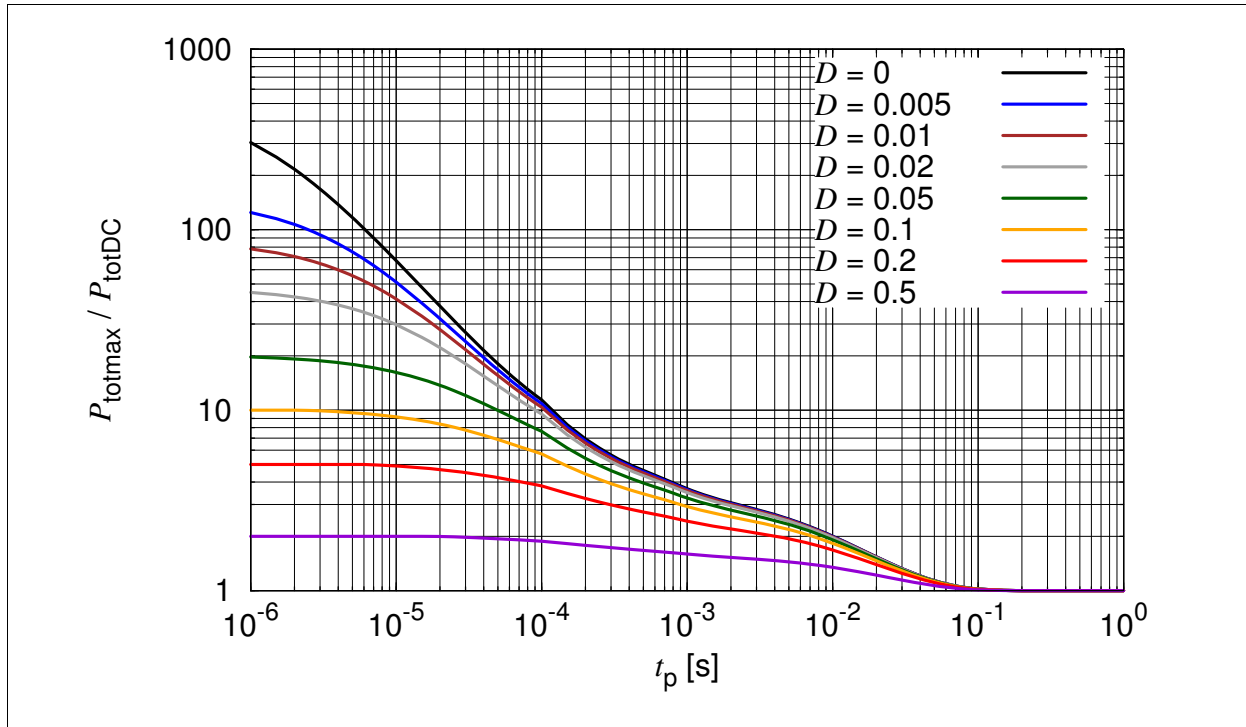


Figure 3-3 Permissible Pulse Load  $P_{totmax} / P_{totDC} = f(t_p)$

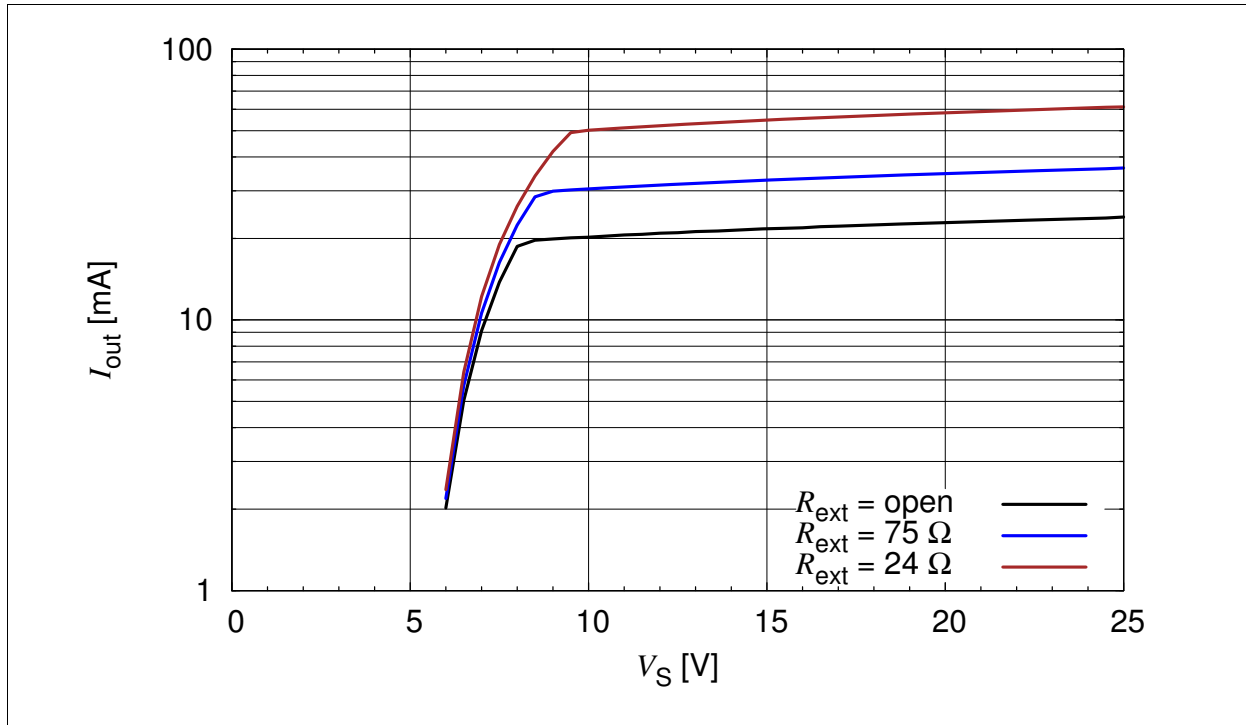


Figure 3-4 Output Current versus  $V_S$   $I_{out} = f(V_S)$ ,  $V_S - V_{out} = 1.4$  V,  $R_{ext} = \text{Parameter}$

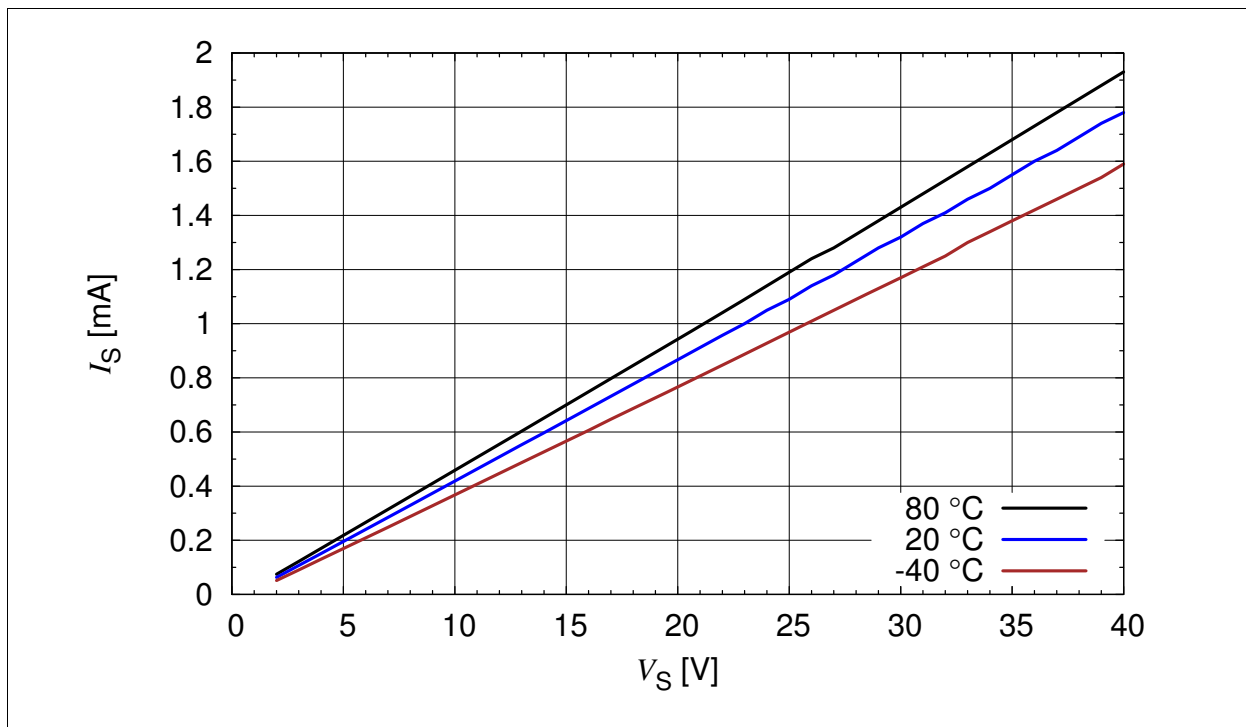


Figure 3-5 Supply Current versus  $V_S$   $I_S = f(V_S)$ ,  $T_A = \text{Parameter}$

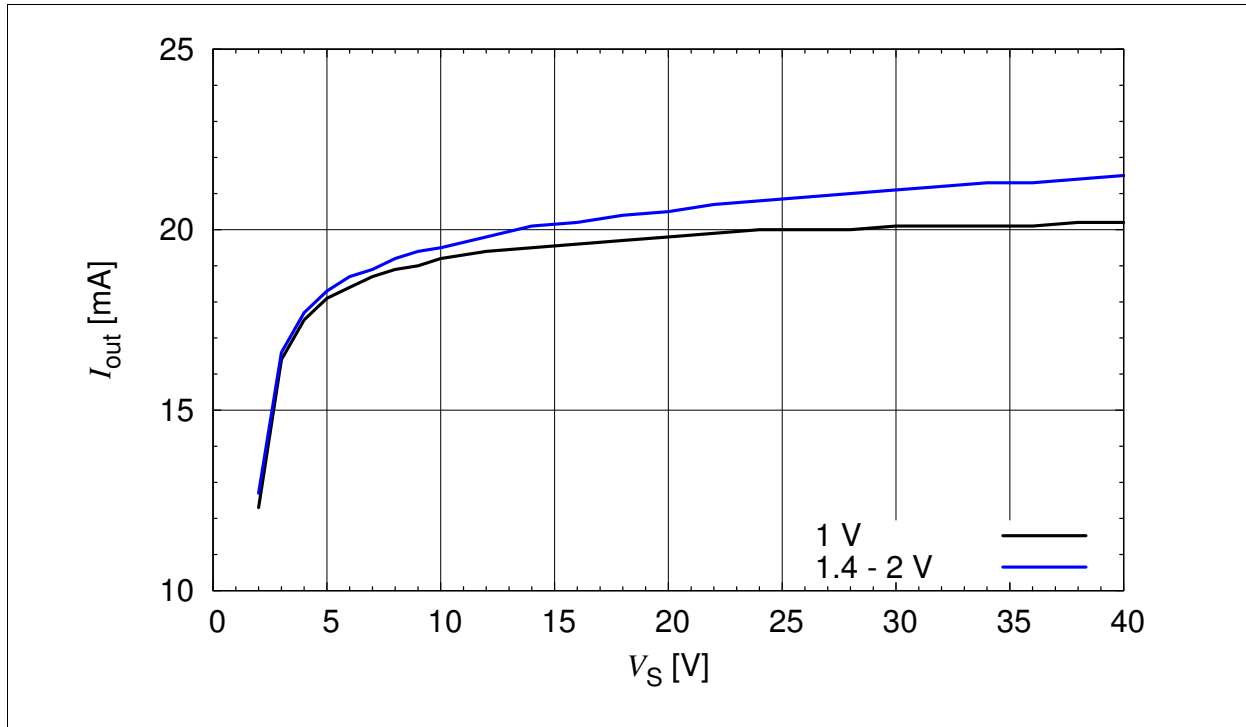


Figure 3-6 Output Current versus  $V_S$   $I_{out} = f(V_S)$ ,  $V_S - V_{out} = \text{Parameter}$

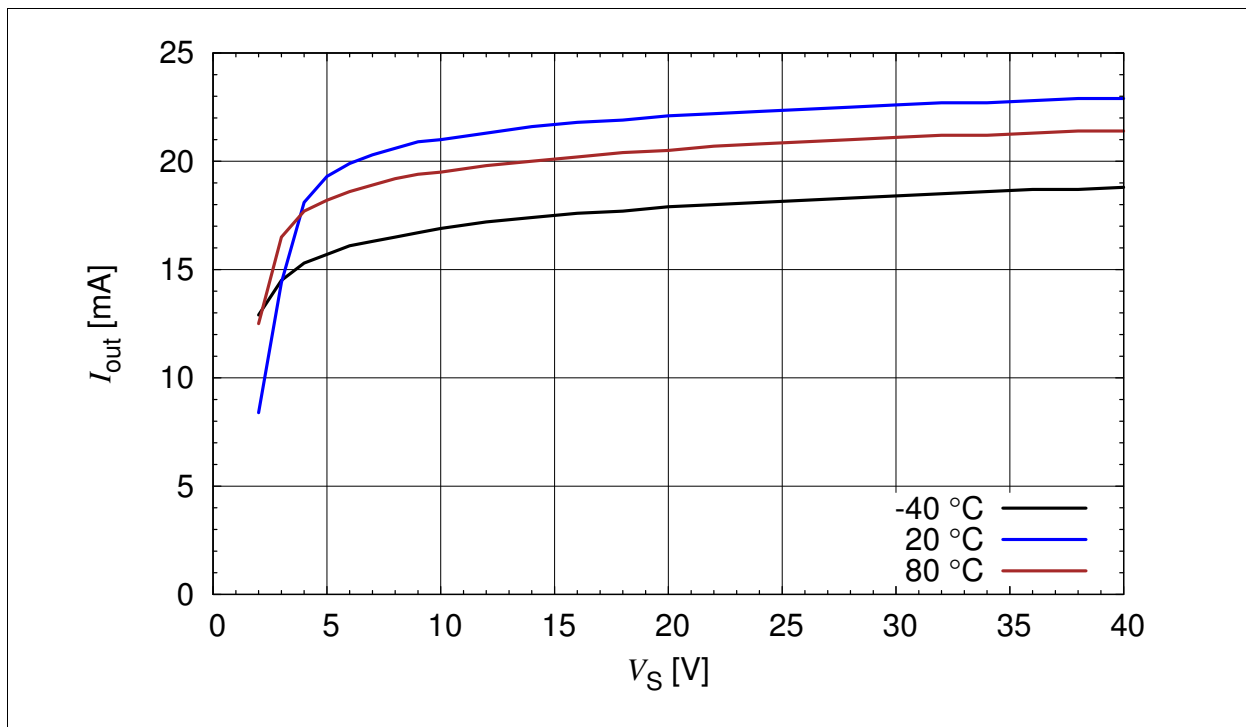


Figure 3-7 Output Current versus  $V_S$   $I_{out} = f(V_S)$ ,  $V_S - V_{out} = 1.4 \text{ V}$ ,  $T_A = \text{Parameter}$

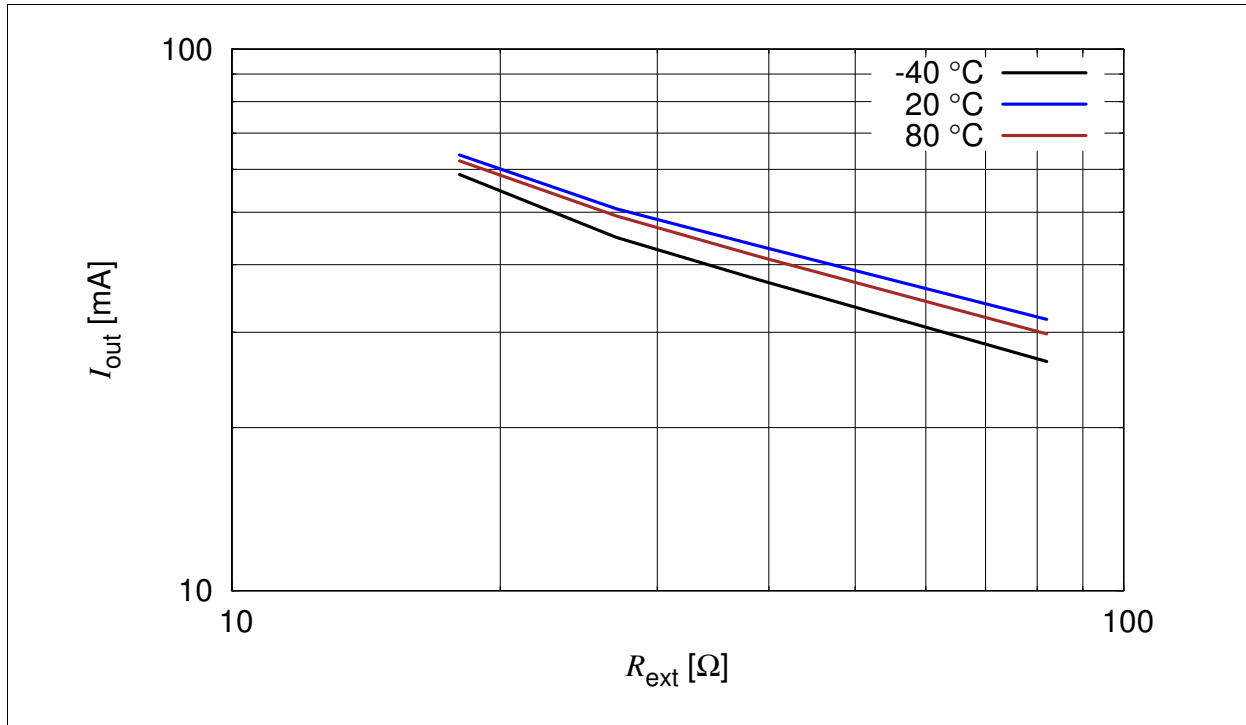


Figure 3-8 Output Current versus  $R_{ext}$   $I_{out} = f(R_{ext})$ ,  $V_S = 10\text{ V}$ ,  $V_S - V_{out} = 1.4\text{ V}$ ,  $T_A = \text{Parameter}$

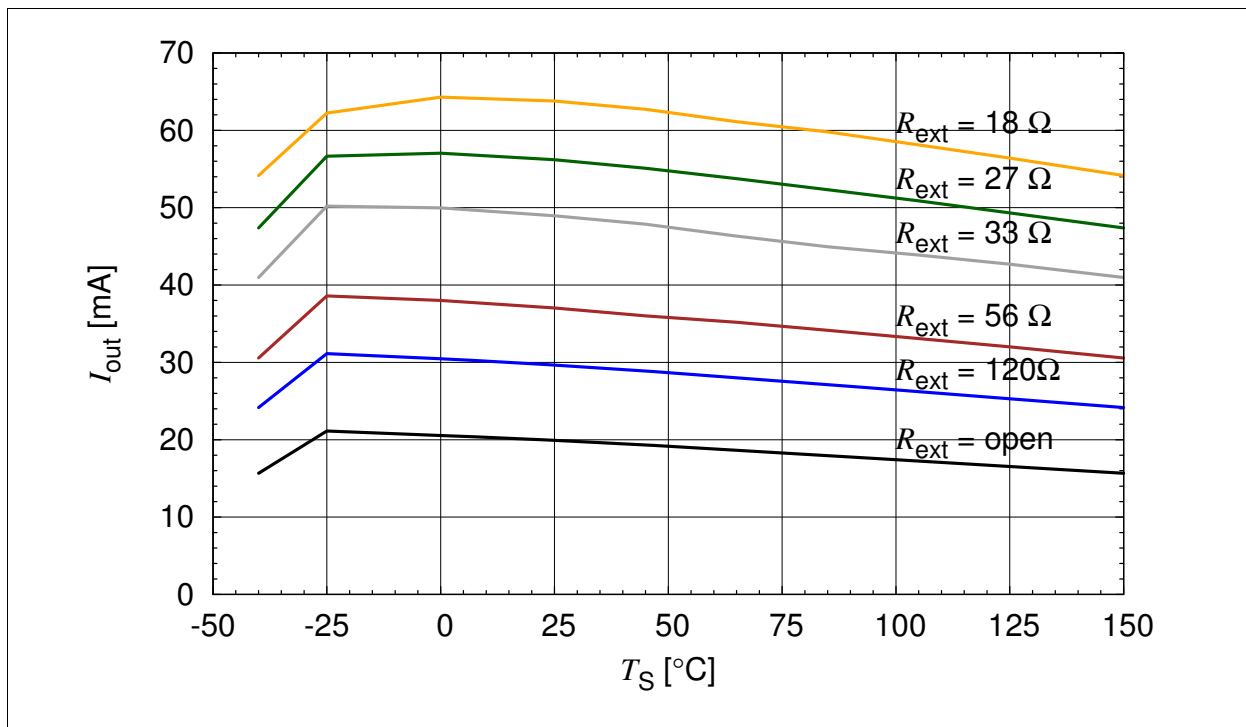


Figure 3-9 Output Current versus  $T_S$   $I_{out} = f(T_S)$ ,  $V_S = 10\text{ V}$ ,  $V_S - V_{out} = 1.4\text{ V}$ ,  $R_{ext} = \text{Parameter}$

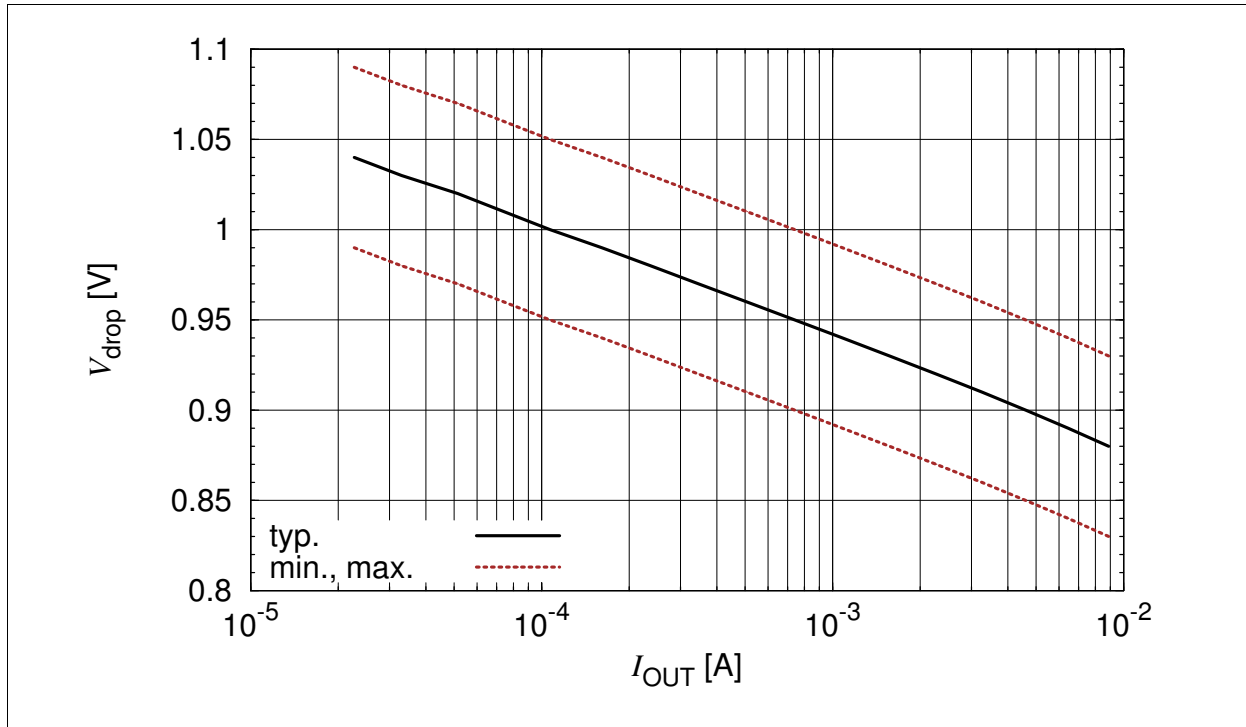


Figure 3-10 Reference Voltage  $V_{drop}$  vs  $I_{out}$   $V_{drop} = f(I_{out})$ ,  $I_{out} = 10 \mu\text{A}$  to 10 mA

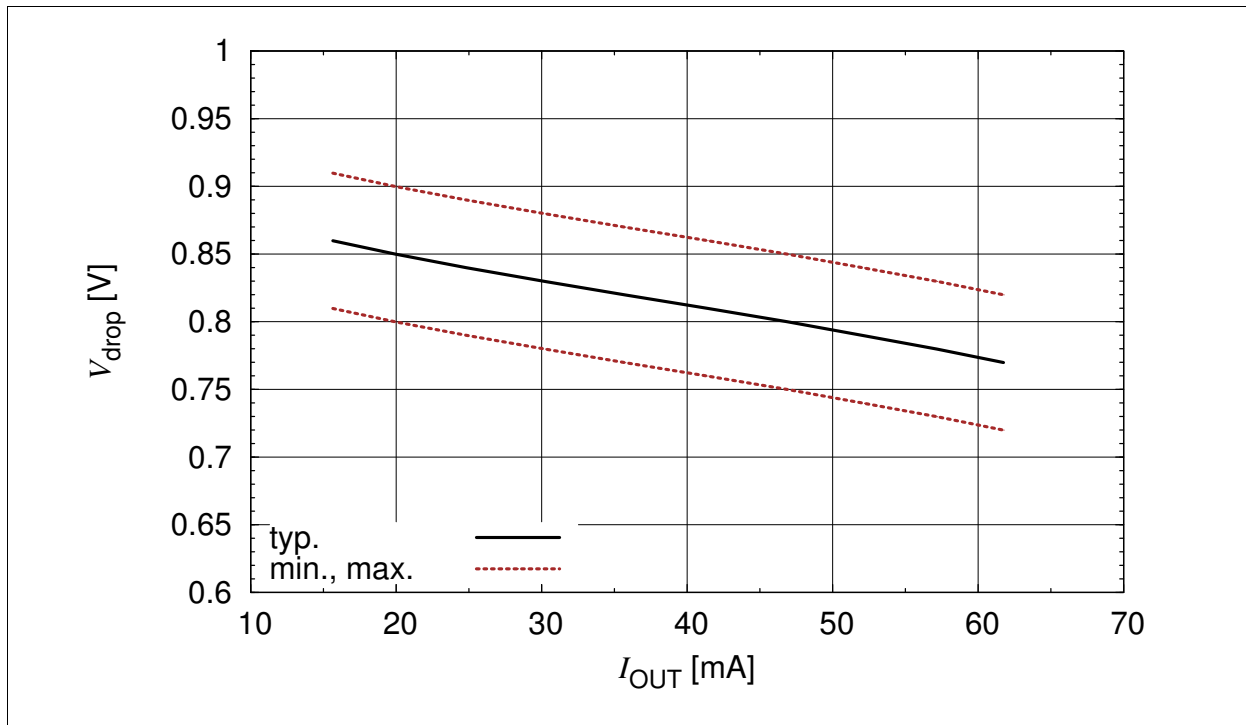


Figure 3-11 Reference Voltage  $V_{drop}$  vs  $I_{out}$   $V_{drop} = f(I_{out})$ ,  $I_{out} = 10 \text{ mA}$  to 65 mA

## 4 Application hints

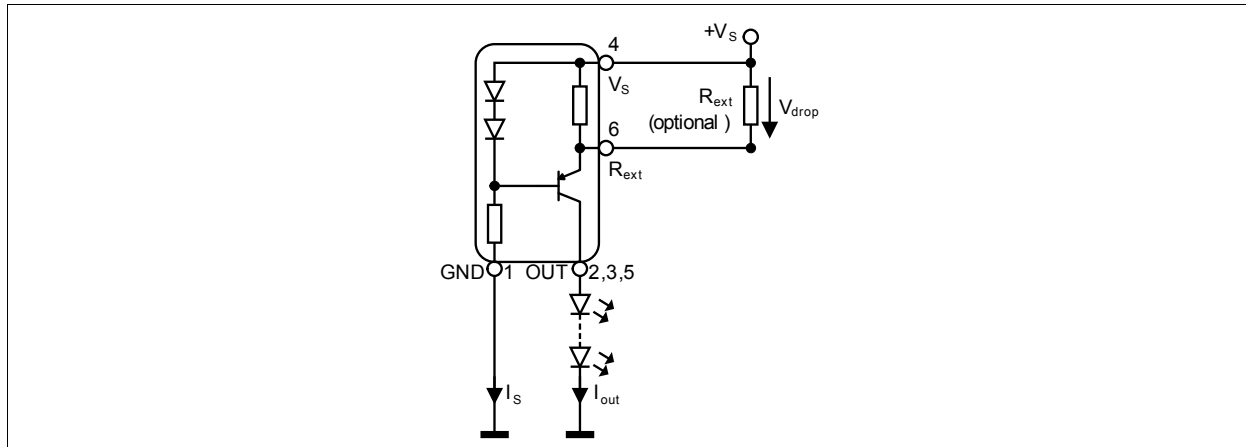


Figure 4-1 Application Circuit: Stand alone current source

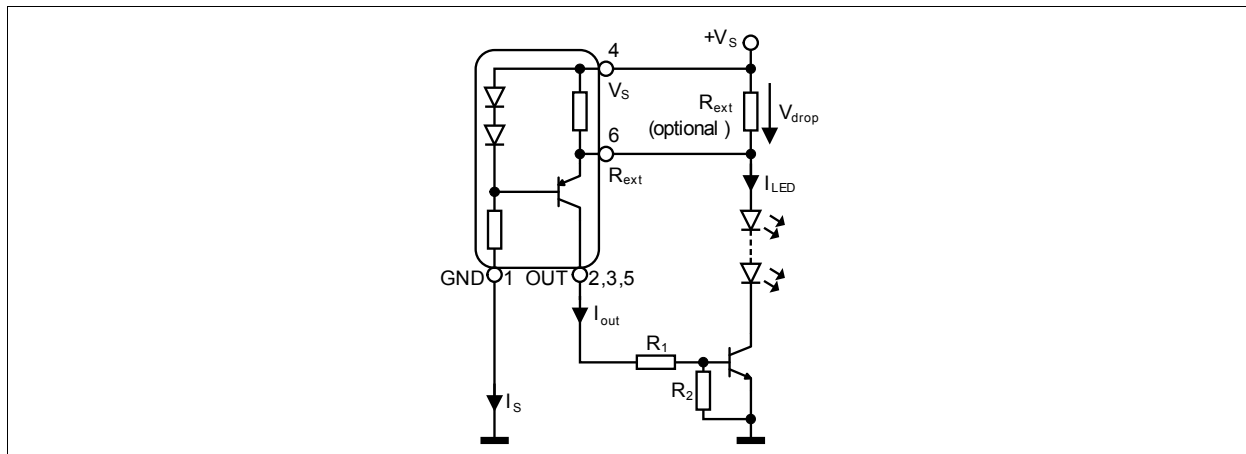


Figure 4-2 Application Circuit: Boost mode current source with external power transistor

### 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/lowcostleddriver](http://www.infineon.com/lowcostleddriver) for detailed application notes.



## 5 Package

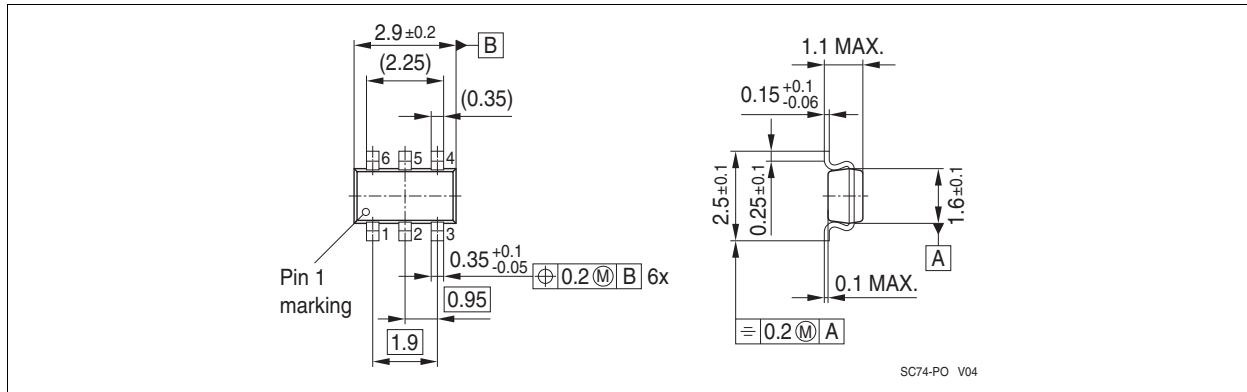


Figure 5-1 Package Outline for SC74 (dimensions in mm)

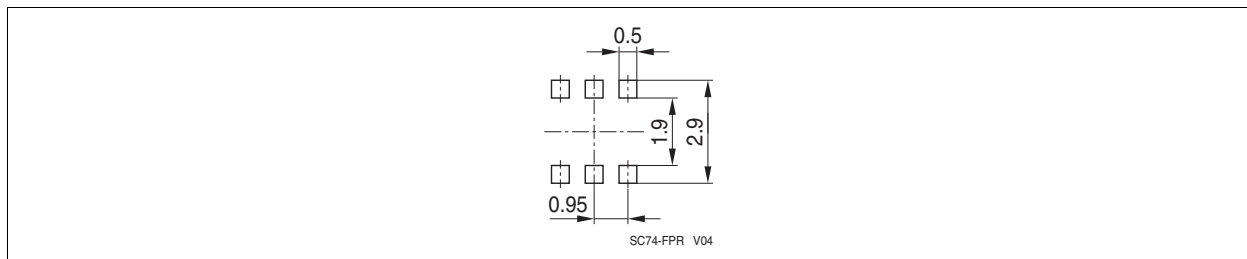


Figure 5-2 Package Footprint for SC74 (dimensions in mm)

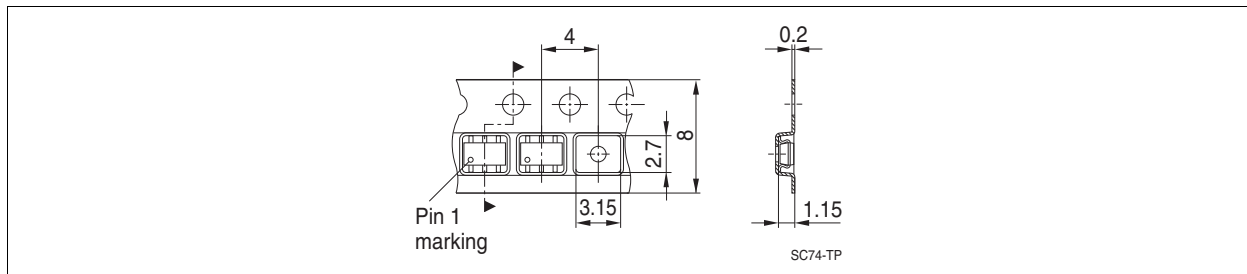


Figure 5-3 Tape and Reel Information for SC74 (dimensions in mm)

## 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

www.infineon.com

Published by Infineon Technologies AG