# NCR401T

## 10 mA LED driver in SOT23

16 October 2015 Product data sheet

## 1. General description

LED driver consisting of a resistor-equipped PNP transistor with two diodes on one chip in a small SOT23 plastic package.

## 2. Features and benefits

- Stabilized output current of 10 mA
- High currrent accuracy at supply voltage variation
- Reduces component count and board space
- Qualified according to AEC-Q101

## 3. Applications

- Constant current LED driver
- Generic constant current source
- Automotive applications

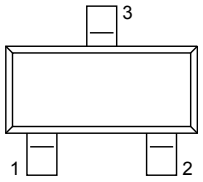
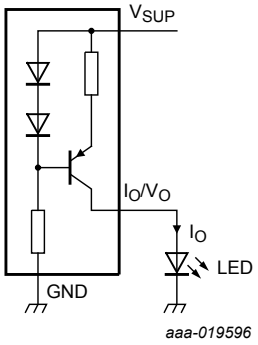
## 4. Quick reference data

**Table 1. Quick reference data**

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $I_O$ | output current | $V_{SUP}$ = 10 V; $V_O$ = 8.6 V; $T_{amb}$ = 25 °C; pulsed; $t_p \leq 300$ µs; $\delta \leq 0.02$ | | 8.5 | 10 | 11.5 | mA |
| $V_{SUP}$ | supply voltage | | | - | - | 18 | V |

## 5. Pinning information

**Table 2. Pinning information**

| Pin | Symbol | Description | Simplified outline | Graphic symbol |
|---|---|---|---|---|
| 1 | GND | ground |   TO-236AB (SOT23) |   |
| 2 | $V_{SUP}$ | supply voltage | | |
| 3 | $I_O/V_O$ | output current/output voltage | | |

## 6. Ordering information

**Table 3. Ordering information**

| Type number | Package | | |
|---|---|---|---|
| | Name | Description | Version |
| NCR401T | TO-236AB | plastic surface-mounted package; 3 leads | SOT23 |

## 7. Marking

**Table 4. Marking codes**

| Type number | Marking code |
|---|---|
| NCR401T | BE |

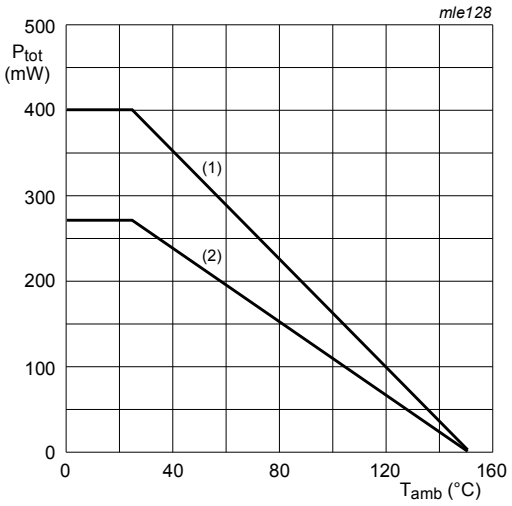
# 8. Limiting values

**Table 5. Limiting values**

*In accordance with the Absolute Maximum Rating System (IEC 60134).*

| Symbol | Parameter | Conditions | | Min | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{SUP}$ | supply voltage | | | - | 18 | V |
| $V_O$ | output voltage | $V_{SUP}$ = 18 V | | - | 16 | V |
| $V_R$ | reverse voltage | | [1] | - | 0.5 | V |
| $P_{tot}$ | total power dissipation | $T_{amb} \leq 25$ °C | [2] | - | 270 | mW |
| | | | [3] | - | 400 | mW |
| $T_j$ | junction temperature | | | - | 150 | °C |
| $T_{amb}$ | ambient temperature | | | -55 | 150 | °C |
| $T_{stg}$ | storage temperature | | | -65 | 150 | °C |

[1] Between all terminals.
[2] Device mounted on an FR4 Printed-Circuit Board (PCB); single-sided copper; tin-plated and standard footprint.
[3] Device mounted on an FR4 PCB; single-sided copper; tin-plated and mounting pad for output 1 $cm^2$.




(1) FR4 PCB mounting pad for collector 1 $cm^2$
(2) FR4 PCB, standard footprint

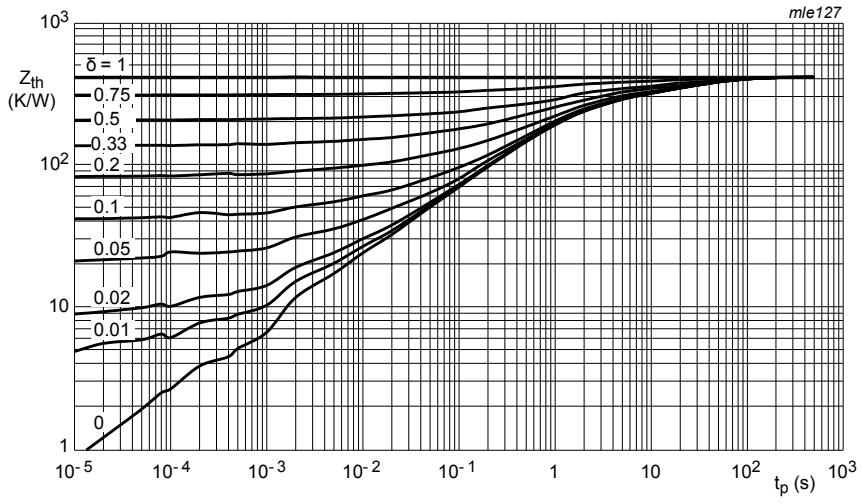
**Fig. 1. Power derating curves**

# 9. Thermal characteristics

**Table 6. Thermal characteristics**

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | in free air | [1] | - | - | 465 | K/W |
| | | | [2] | - | - | 312 | K/W |

[1] Device mounted on an FR4 PCB; single-sided copper; tin-plated and standard footprint.
[2] Device mounted on an FR4 PCB; single-sided copper; tin-plated and mounting pad for collector 1 $cm^2$.



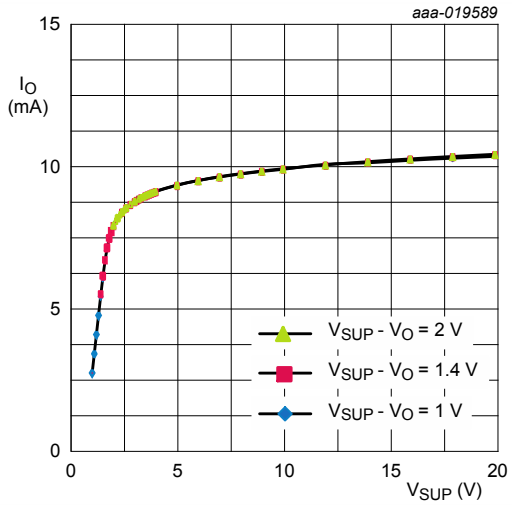

FR4 PCB, single sided copper, standard footprint

**Fig. 2. Transient thermal impedance as a function of pulse time; typical values**

# 10. Characteristics

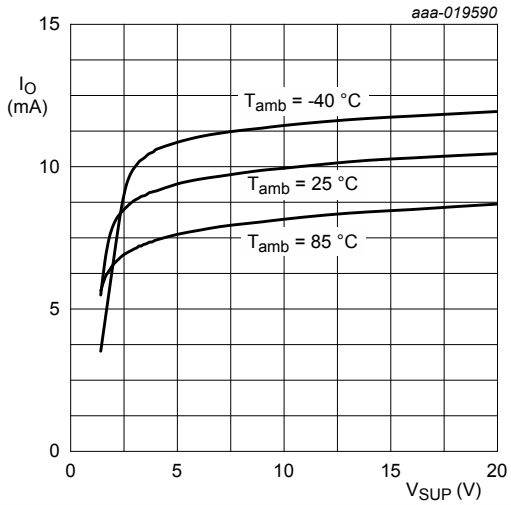
**Table 7. Characteristics**

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $I_O$ | output current | $V_{SUP}$ = 10 V; $V_O$ = 8.6 V; $T_{amb}$ = 25 °C; pulsed; $t_p \leq 300$ µs; $\delta \leq 0.02$ | | 8.5 | 10 | 11.5 | mA |
| $I_{GND}$ | ground current | $V_{SUP}$ = 10 V; $I_O$ = 0 A; $T_{amb}$ = 25 °C; pulsed; $t_p \leq 300$ µs; $\delta \leq 0.02$ | | 340 | 420 | 500 | µA |
| $V_{(VSUP-VO)min}$ | minimum voltage between supply voltage and output voltage | $I_O$ > 8.5 mA; $T_{amb}$ = 25 °C; pulsed; $t_p \leq 300$ µs; $\delta \leq 0.02$ | | - | 1.4 | - | V |
| $\Delta I_O / (I_O \times \Delta T_{amb})$ | relative output current variation with ambient temperature | $V_{SUP}$ = 10 V; $V_O$ = 8.6 V; $T_{amb}$ = 25 °C; pulsed; $t_p \leq 300$ µs; $\delta \leq 0.02$ | | - | -0.3 | - | %/K |
| $\Delta I_O / (I_O \times \Delta V_{SUP})$ | relative output current variation with supply voltage | $V_{SUP}$ = 10 V; $V_{SUP}$ - $V_O$ = 1.4 V; $T_{amb}$ = 25 °C; pulsed; $t_p \leq 300$ µs; $\delta \leq 0.02$ | | - | 0.8 | - | %/V |



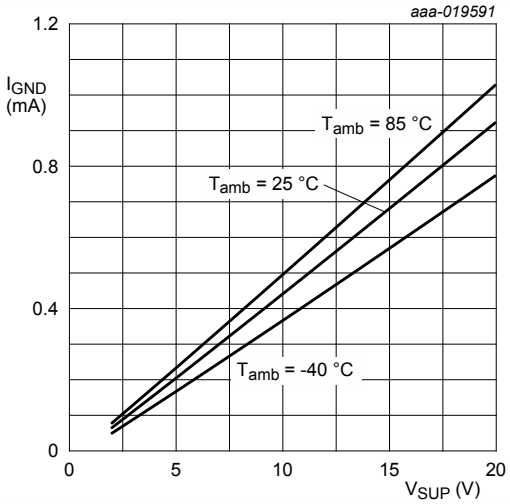

$T_{amb}$ = 25 °C

**Fig. 3. Output current as a function of supply voltage; typical values**




$V_{SUP}$ - $V_O$ = 1.4 V

**Fig. 4. Output current as a function of supply voltage; typical values**




$I_O$ = 0 A

**Fig. 5. Ground current as a function of supply voltage; typical values**

## 11. Application information

Fig. 6 shows a typical application circuit for an LED driver. The constant current ensures a constant LED brightness. The output current slightly decreases when the power load at the LED driver increases. This effect is due to self heating of the device and the negative thermal coefficient of the output current.

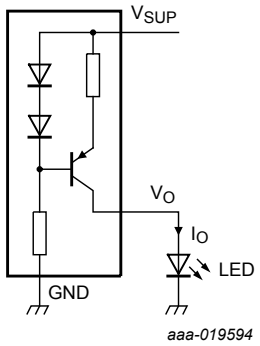



**Fig. 6. LED driver application diagram**

The output can be switched ON and OFF by connecting a Resistor-Equipped Transistor (RET), e.g. PDTC124XU; see Fig. 7

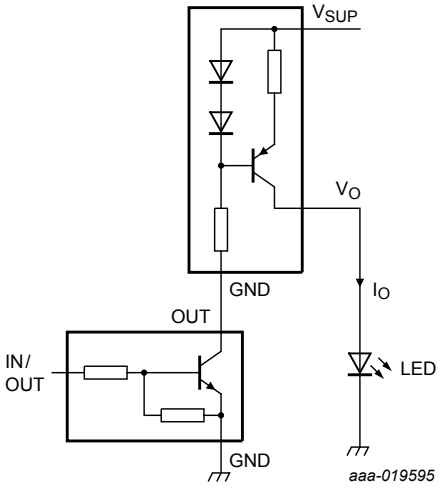



**Fig. 7. Switching current ON/OFF; application diagram**

# 12. Test information

## 12.1 Quality information

This product has been qualified in accordance with the Automotive Electronics Council (AEC) standard Q101 - Stress test qualification for discrete semiconductors, and is suitable for use in automotive applications.

# 13. Package outline

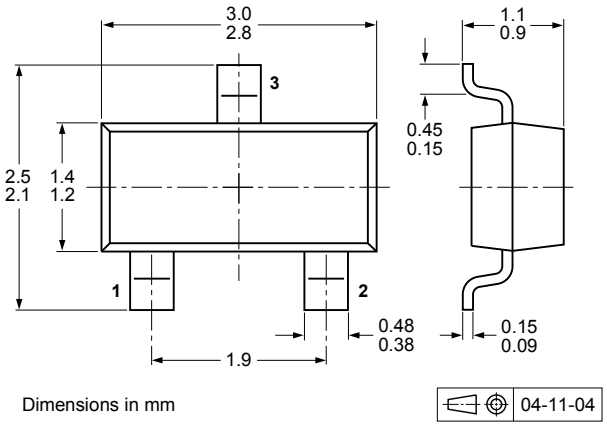



**Fig. 8. Package outline TO-236AB (SOT23)**

# 14. Soldering

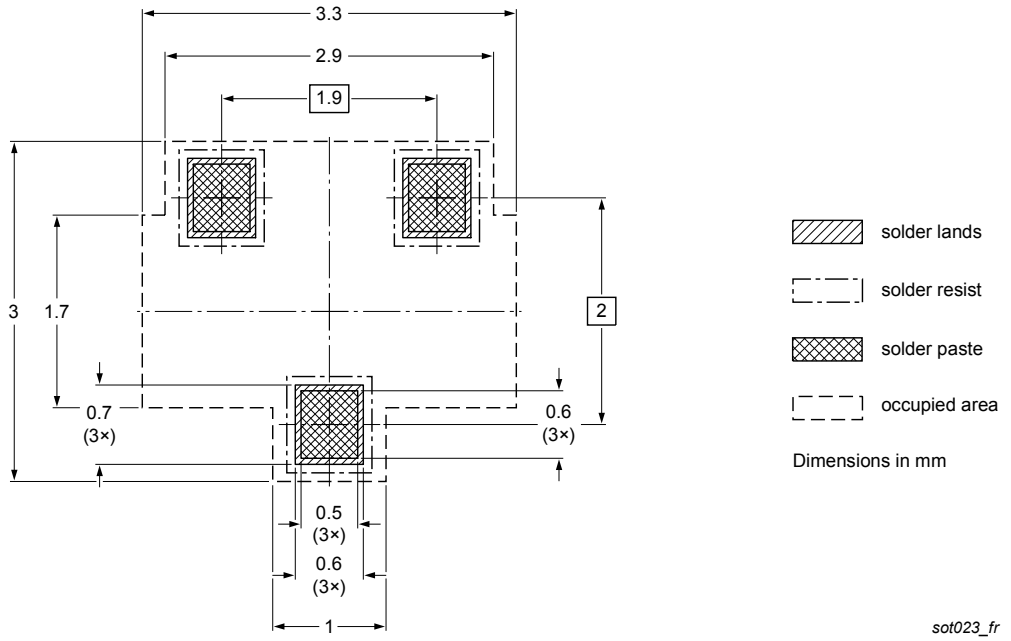



**Fig. 9. Reflow soldering footprint for TO-236AB (SOT23)**

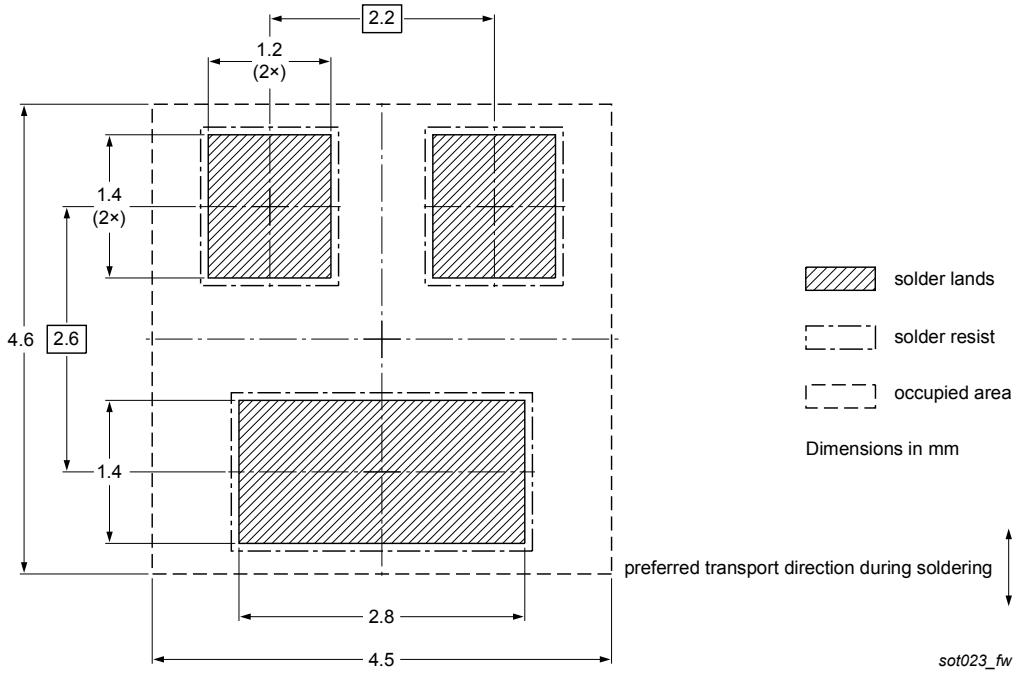



**Fig. 10. Wave soldering footprint for TO-236AB (SOT23)**

# 15. Revision history

**Table 8. Revision history**

| Data sheet ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| NCR401T v.1 | 20151016 | Product data sheet | - | - |

# 16. Legal information

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| Document status [1][2] | Product status [3] | Definition |
|---|---|---|
| Objective [short] data sheet | Development | This document contains data from the objective specification for product development. |
| Preliminary [short] data sheet | Qualification | This document contains data from the preliminary specification. |
| Product [short] data sheet | Production | This document contains the product specification. |

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**Date of release: 16 October 2015**

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