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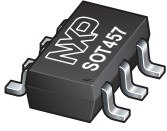
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# NCR401U

10 mA LED driver in SOT457

Rev. 1 — 20 February 2014

Product data sheet

## 1. Product profile

### 1.1 General description

LED driver consisting of resistor-equipped PNP transistor with two diodes on one chip in an SOT457 (SC-74) plastic package.

### 1.2 Features and benefits

- Stabilized output current of 10 mA
- High current accuracy at supply voltage variation
- Low voltage overhead of 1.4 V
- Qualified according to AEC-Q101
- Reduces component count and board space
- High power dissipation of 750 mW
- Stabilized output current adjustable up to 65 mA when an external resistor is used

### 1.3 Applications

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

### 1.4 Quick reference data

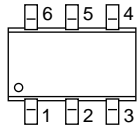
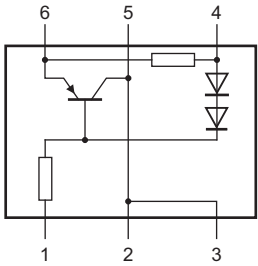
Table 1. Quick reference data

| Symbol    | Parameter                 | Conditions                                  | Min | Typ | Max  | Unit |
|-----------|---------------------------|---|-----|-----|------|------|
| $I_{out}$ | stabilized output current | $V_S = 10\text{ V}; V_{out} = 8.6\text{ V}$ | 8.5 | 10  | 11.5 | mA   |
| $V_S$     | supply voltage            |   | -   | -   | 40   | V    |



## 2. Pinning information

Table 2. Pinning

| Pin | Symbol | Description       | Simplified outline   | Graphic symbol  |
|-----|--------|-------------------|--|---|
| 1   | GND    | ground            |  |  |
| 2   | IOUT   | output current    |  |   |
| 3   | IOUT   | output current    |  |   |
| 4   | VS     | supply voltage    |  |   |
| 5   | IOUT   | output current    |  |   |
| 6   | REXT   | external resistor |  |   |

*aaa-010101*

## 3. Ordering information

Table 3. Ordering information

| Type number | Package       |  |         |
|-------------|---------------|--|---------|
|             | Name          | Description                              | Version |
| NCR401U     | SC-74 (TSOP6) | plastic surface-mounted package; 6 leads | SOT457  |

## 4. Marking

Table 4. Marking codes

| Type number | Marking code |
|-------------|--------------|
| NCR401U     | DA           |

## 5. Limiting values

**Table 5. Limiting values**

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

| Symbol    | Parameter  | Conditions                  | Min | Max  | Unit |    |
|-----------|--|-----------------------------|-----|------|------|----|
| $I_{out}$ | stabilized output current if external resistor is used |                             | -   | 65   | mA   |    |
| $V_S$     | supply voltage   |                             | -   | 40   | V    |    |
| $V_{out}$ | output voltage   | $V_S = 40\text{ V}$         | -   | 38   | V    |    |
| $V_R$     | reverse voltage  |                             | [1] | 0.5  | V    |    |
| $P_{tot}$ | total power dissipation                                | $T_{amb} \leq 25\text{ °C}$ | [2] | -    | 475  | mW |
|           |  | $T_{amb} \leq 25\text{ °C}$ | [3] | -    | 650  | mW |
|           |  | $T_{amb} \leq 25\text{ °C}$ | [4] | -    | 750  | mW |
|           |  | $T_{amb} \leq 25\text{ °C}$ | [5] | -    | 1100 | mW |
| $T_j$     | junction temperature                                   |                             | -   | 150  | °C   |    |
| $T_{amb}$ | ambient temperature                                    |                             | -55 | +150 | °C   |    |
| $T_{stg}$ | storage temperature                                    |                             | -65 | +150 | °C   |    |

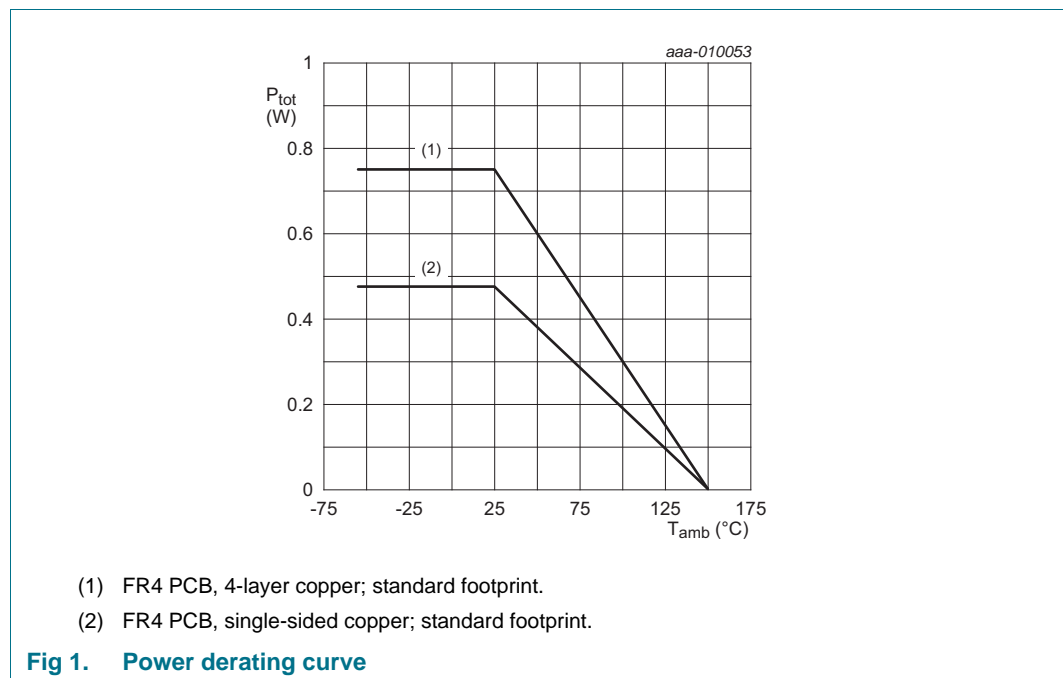
[1] Between all terminals.

[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<sup>2</sup>.

[4] Device mounted on an FR4 PCB; 4-layer copper; tin-plated and standard footprint.

[5] Device mounted on an FR4 PCB; 4-layer copper; tin-plated and mounting pad for output 1 cm<sup>2</sup>.

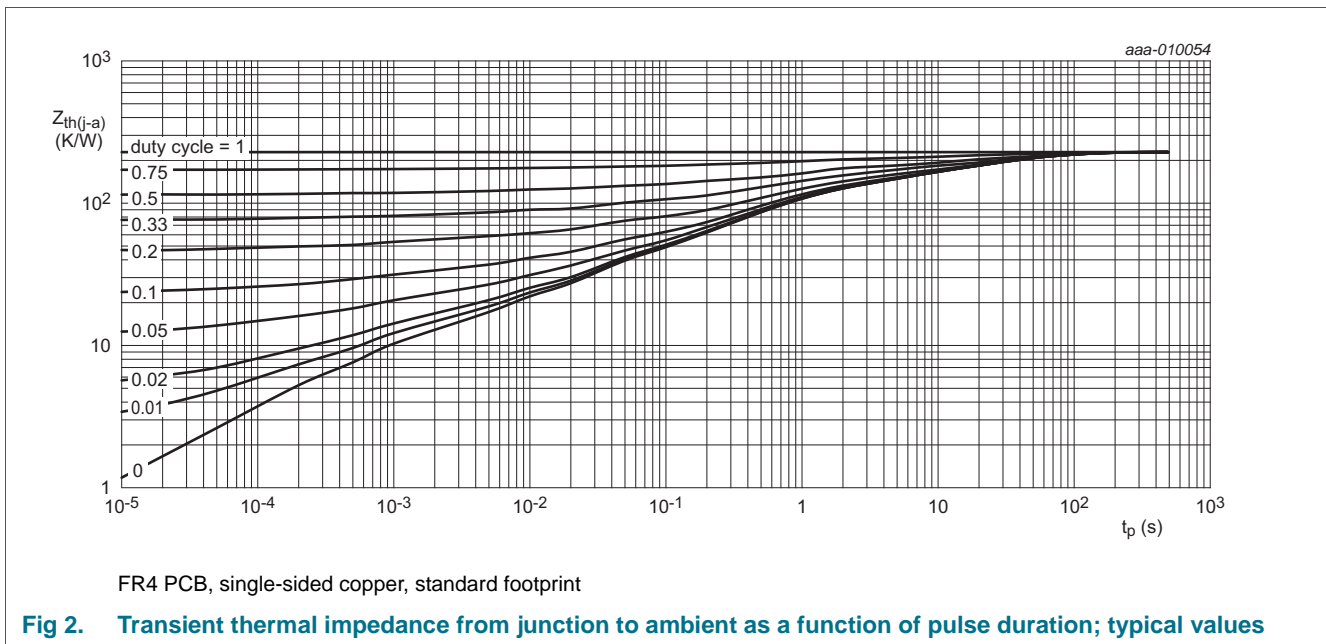


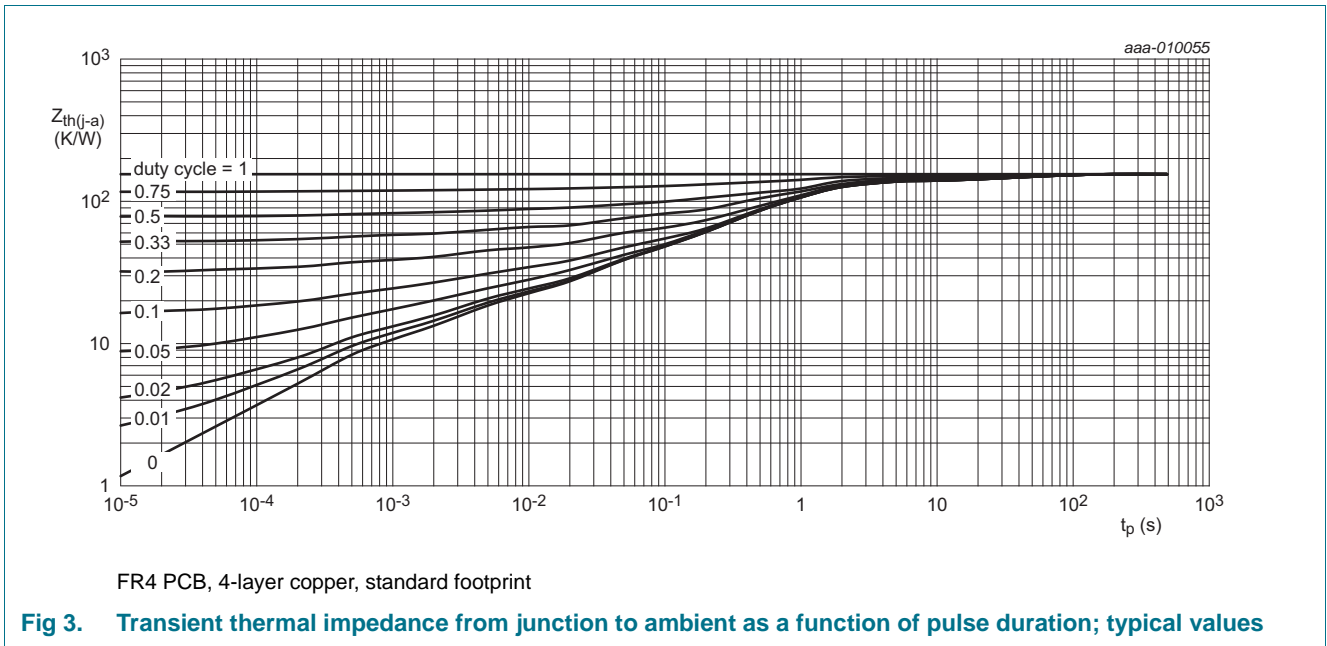
## 6. Thermal characteristics

**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] - | -   | 265 | K/W  |
|                |  |             | [2] - | -   | 190 | K/W  |
|                |  |             | [3] - | -   | 165 | K/W  |
|                |  |             | [4] - | -   | 115 | K/W  |
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point | in free air | -     | -   | 50  | 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 output 1 cm<sup>2</sup>.
- [3] Device mounted on an FR4 PCB; 4-layer copper; tin-plated and standard footprint.
- [4] Device mounted on an FR4 PCB; 4-layer copper; tin-plated and mounting pad for output 1 cm<sup>2</sup>.



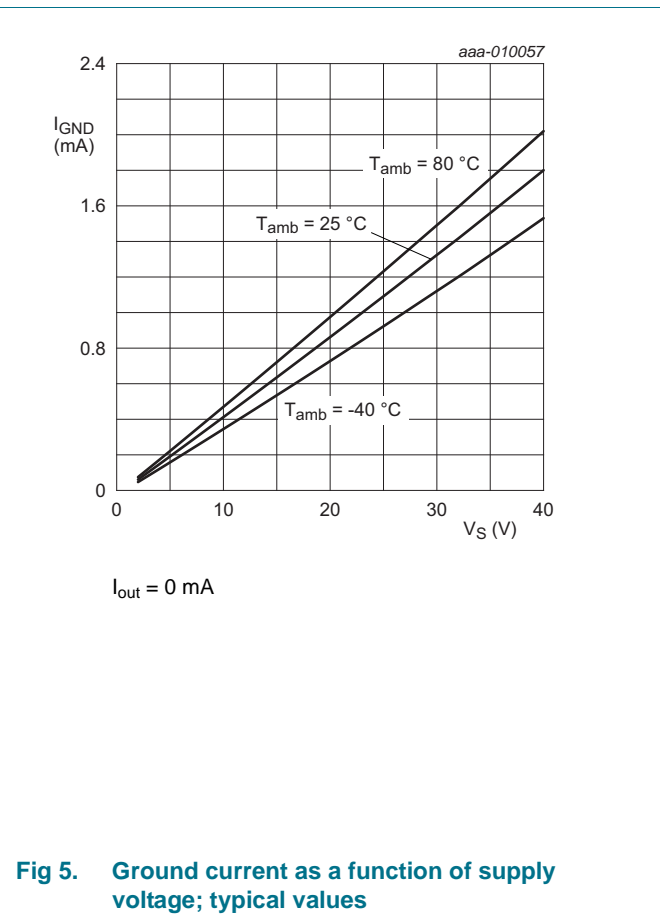
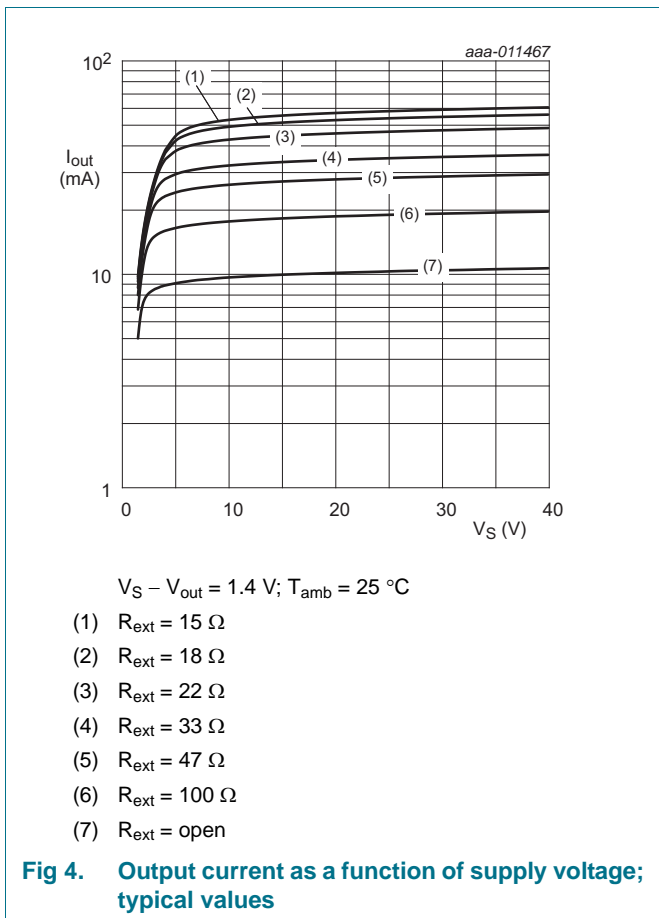


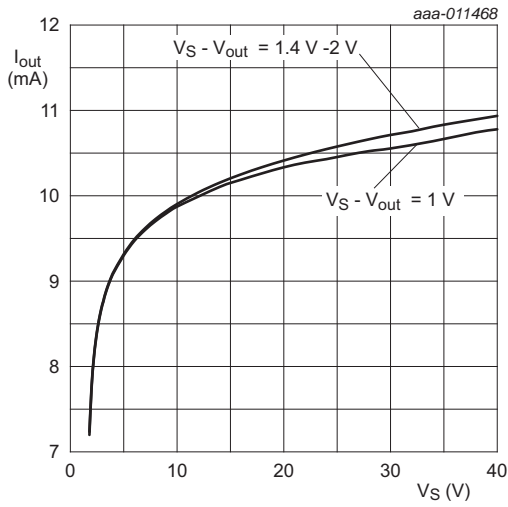
## 7. Characteristics

**Table 7. Characteristics**

$T_{amb} = 25\text{ }^{\circ}\text{C}$ ; pulse test:  $t_p \leq 300\text{ }\mu\text{s}$ ;  $\delta = 0.02$ ; unless otherwise specified.

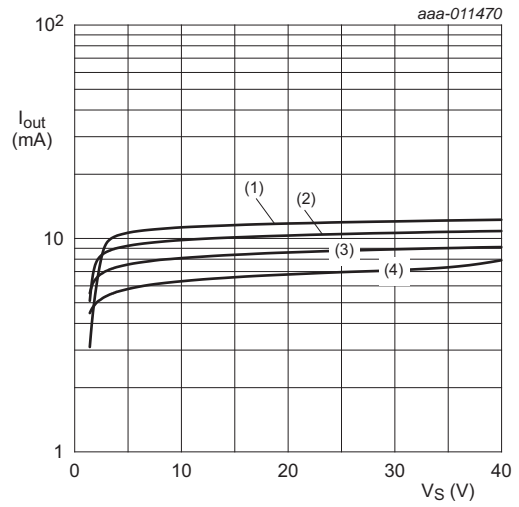
| Symbol   | Parameter   | Conditions  | Min | Typ  | Max  | Unit          |
|--|---|---|-----|------|------|---------------|
| $I_{out}$  | stabilized output current                                 | $V_S = 10\text{ V}$ ; $V_{out} = 8.6\text{ V}$          | 8.5 | 10   | 11.5 | mA            |
| $I_{GND}$  | ground current  | $V_S = 10\text{ V}$ ; $I_{out} = 0\text{ A}$            | 340 | 420  | 500  | $\mu\text{A}$ |
| $R_{int}$  | internal resistance                                       | $I_{Rint} = 10\text{ mA}$                               | 75  | 88   | 101  | $\Omega$      |
| $V_{Rint}$   | voltage drop at internal resistance $R_{int}$             | $I_{out} = 10\text{ mA}$                                | -   | 0.88 | -    | V             |
| $V_{Smin}$   | lowest sufficient supply voltage overhead $V_S - V_{out}$ | $I_{out} > 8.5\text{ mA}$                               | -   | 1.4  | -    | V             |
| $\Delta I_{out} / (I_{out} \times \Delta T_{amb})$ | stabilized output current change over ambient temperature | $V_S = 10\text{ V}$ ; $V_{out} = 8.6\text{ V}$          | -   | -0.3 | -    | %/K           |
| $\Delta I_{out} / (I_{out} \times \Delta V_S)$     | stabilized output current change over supply voltage      | $V_S = 10\text{ V}$ ;<br>$V_S - V_{out} = 1.4\text{ V}$ | -   | 0.8  | -    | %/V           |





$R_{ext} = \text{open}; T_{amb} = 25\text{ }^{\circ}\text{C}$

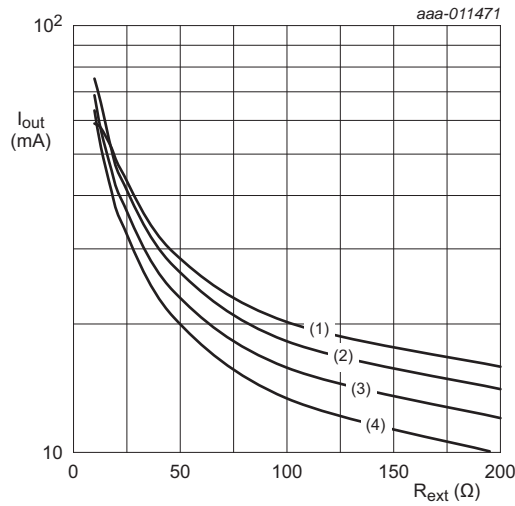
**Fig 6. Output current as a function of supply voltage; typical values**



$V_S - V_{out} = 1.4\text{ V}; R_{ext} = \text{open}$

- (1)  $T_{amb} = -40\text{ }^{\circ}\text{C}$
- (2)  $T_{amb} = +25\text{ }^{\circ}\text{C}$
- (3)  $T_{amb} = +80\text{ }^{\circ}\text{C}$
- (4)  $T_{amb} = +150\text{ }^{\circ}\text{C}$

**Fig 7. Output current as a function of supply voltage; typical values**



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

- (1)  $T_{amb} = -40\text{ }^{\circ}\text{C}$
- (2)  $T_{amb} = +25\text{ }^{\circ}\text{C}$
- (3)  $T_{amb} = +85\text{ }^{\circ}\text{C}$
- (4)  $T_{amb} = +150\text{ }^{\circ}\text{C}$

**Fig 8. Output current as a function of external resistor; typical values**



## 8. Application information

Figure 9 shows a typical application circuit for an LED driver. The constant current ensures a constant LED brightness. The output current can be adjusted between 10 mA and 65 mA by connecting an external resistor  $R_{ext}$ . Figure 8 gives a first indication for choosing the external resistor  $R_{ext}$ . The output current slightly decreases when the power load at LED driver increases. This effect is due to the self heating of the device and the negative thermal coefficient of the output current.

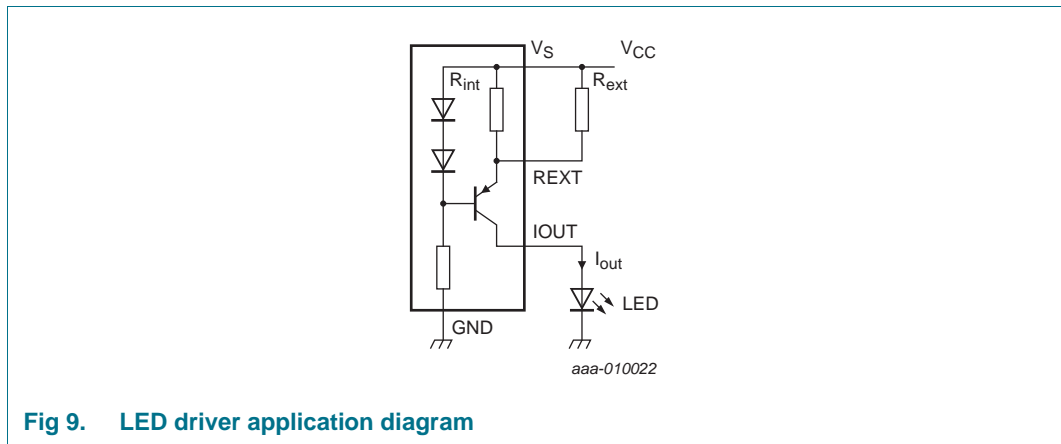


Fig 9. LED driver application diagram

The output can be switched ON and OFF by connecting a Resistor-Equipped Transistor (RET), e.g. PDTC124XU; see Figure 10.

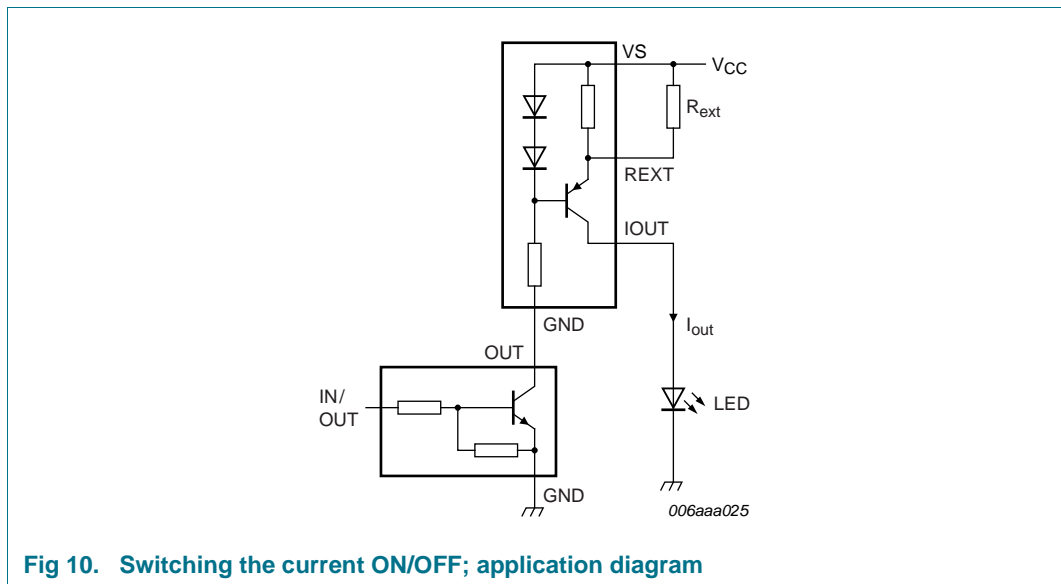


Fig 10. Switching the current ON/OFF; application diagram

## 9. Test information

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### 9.1 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.

### 10. Package outline

Plastic surface-mounted package (TSOP6); 6 leads

SOT457

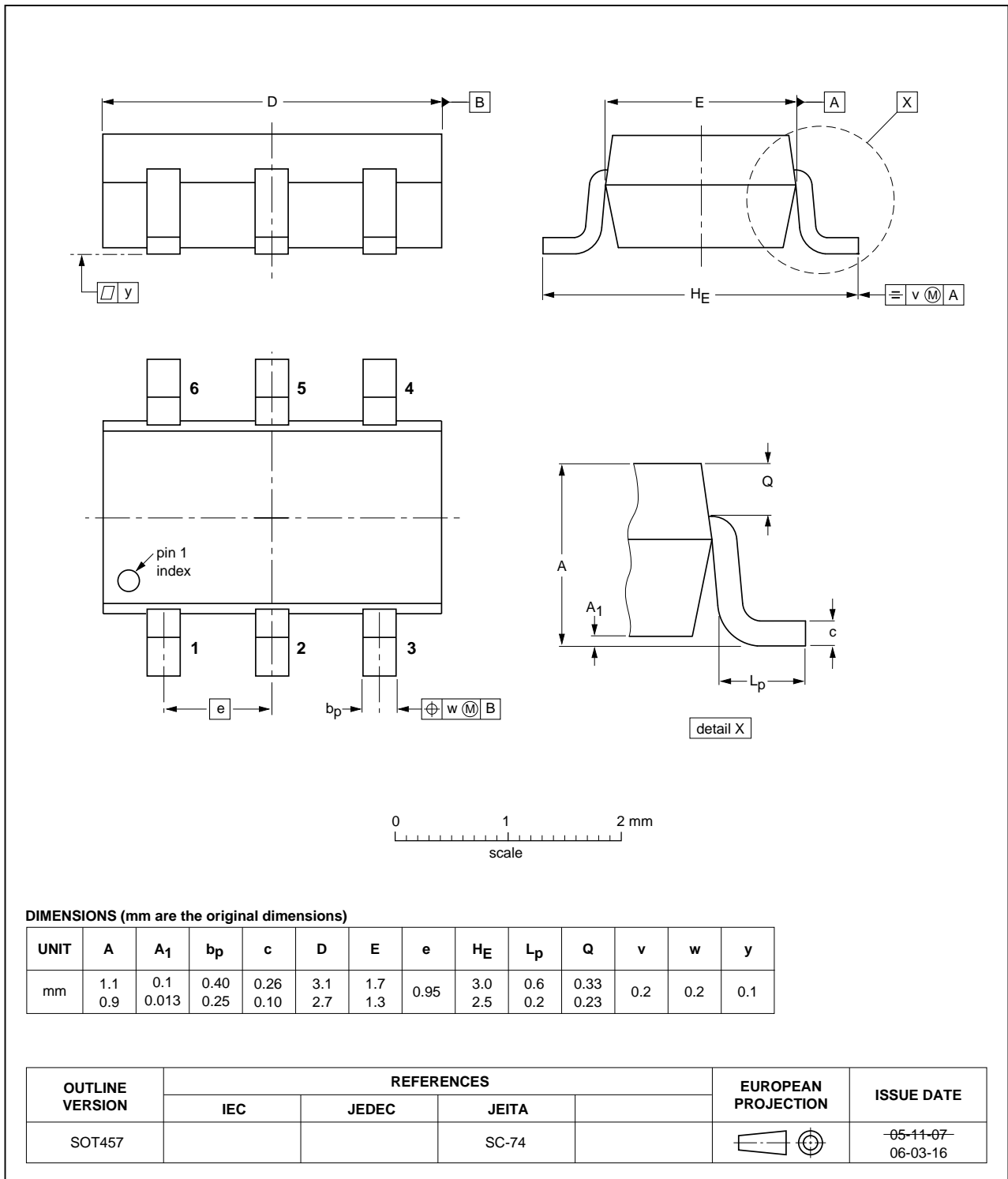


Fig 11. Package outline SOT457 (SC-74)

11. Soldering

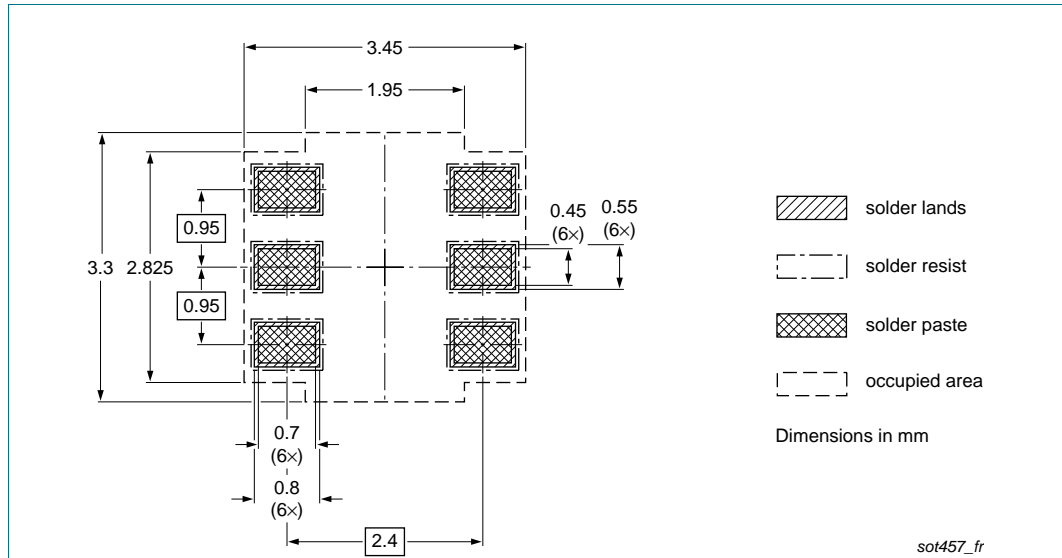


Fig 12. Reflow soldering footprint for SOT457 (SC-74)

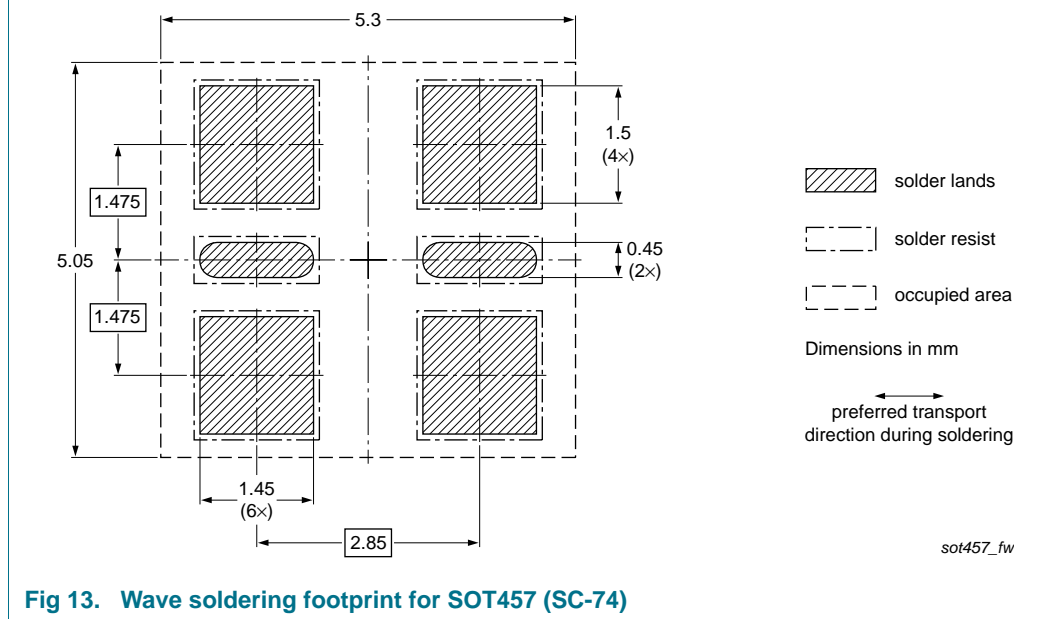


Fig 13. Wave soldering footprint for SOT457 (SC-74)

## 12. Revision history

Table 8. Revision history

| Document ID | Release date | Data sheet status  | Change notice | Supersedes |
|-------------|--------------|--------------------|---------------|------------|
| NCR401U v.1 | 20140220     | Product data sheet | -             | -          |

## 13. Legal information

### 13.1 Data sheet status

| Document status <sup>[1][2]</sup> | Product status <sup>[3]</sup> | 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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## 15. Contents

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|           |  |           |
|-----------|--|-----------|
| <b>1</b>  | <b>Product profile</b> . . . . .         | <b>1</b>  |
| 1.1       | General description . . . . .            | 1         |
| 1.2       | Features and benefits . . . . .          | 1         |
| 1.3       | Applications . . . . .                   | 1         |
| 1.4       | Quick reference data . . . . .           | 1         |
| <b>2</b>  | <b>Pinning information</b> . . . . .     | <b>2</b>  |
| <b>3</b>  | <b>Ordering information</b> . . . . .    | <b>2</b>  |
| <b>4</b>  | <b>Marking</b> . . . . .                 | <b>2</b>  |
| <b>5</b>  | <b>Limiting values</b> . . . . .         | <b>3</b>  |
| <b>6</b>  | <b>Thermal characteristics</b> . . . . . | <b>4</b>  |
| <b>7</b>  | <b>Characteristics</b> . . . . .         | <b>6</b>  |
| <b>8</b>  | <b>Application information</b> . . . . . | <b>8</b>  |
| <b>9</b>  | <b>Test information</b> . . . . .        | <b>9</b>  |
| 9.1       | Quality information . . . . .            | 9         |
| <b>10</b> | <b>Package outline</b> . . . . .         | <b>10</b> |
| <b>11</b> | <b>Soldering</b> . . . . .               | <b>11</b> |
| <b>12</b> | <b>Revision history</b> . . . . .        | <b>12</b> |
| <b>13</b> | <b>Legal information</b> . . . . .       | <b>13</b> |
| 13.1      | Data sheet status . . . . .              | 13        |
| 13.2      | Definitions . . . . .                    | 13        |
| 13.3      | Disclaimers . . . . .                    | 13        |
| 13.4      | Trademarks . . . . .                     | 14        |
| <b>14</b> | <b>Contact information</b> . . . . .     | <b>14</b> |
| <b>15</b> | <b>Contents</b> . . . . .                | <b>15</b> |

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