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Kind regards,

Team Nexperia



# 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		

## 3. Ordering information

Table 3. Ordering information

Type number	Package			Version
	Name	Description		
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	$V_S = 40$ V	-	38	V
$V_R$	reverse voltage		[1]	-	0.5 V
$P_{tot}$	total power dissipation	$T_{amb} \leq 25$ °C	[2]	-	475 mW
		$T_{amb} \leq 25$ °C	[3]	-	650 mW
		$T_{amb} \leq 25$ °C	[4]	-	750 mW
		$T_{amb} \leq 25$ °C	[5]	-	1100 mW
$T_j$	junction temperature		-	150	°C
$T_{amb}$	ambient temperature		-55	+150	°C
$T_{stg}$	storage temperature		-65	+150	°C

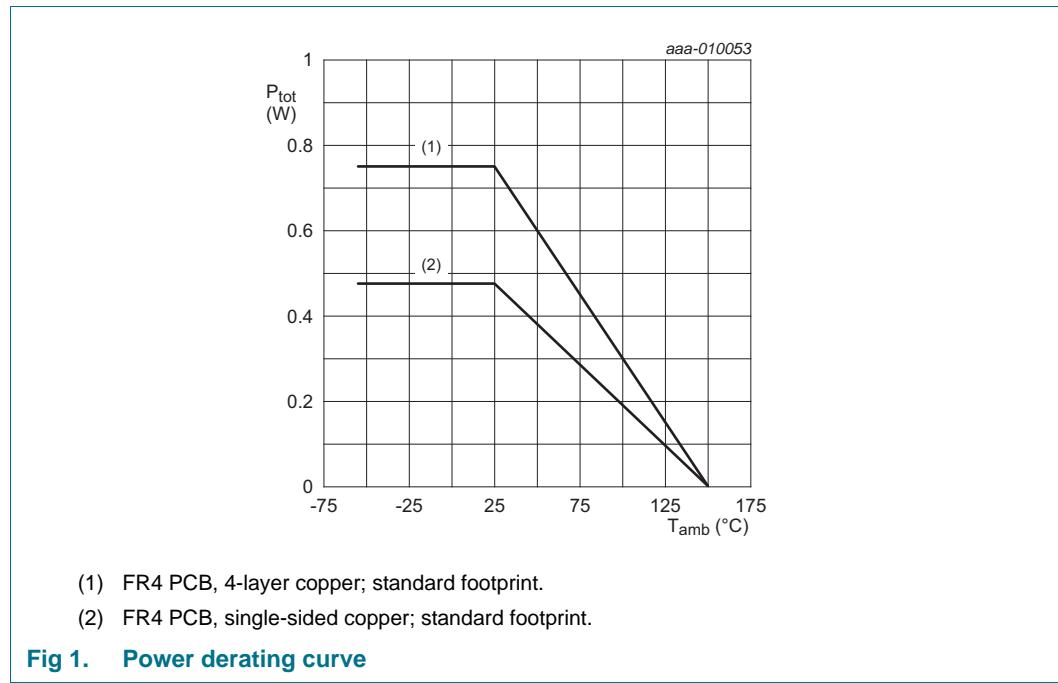
[1] Between all terminals.

[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**

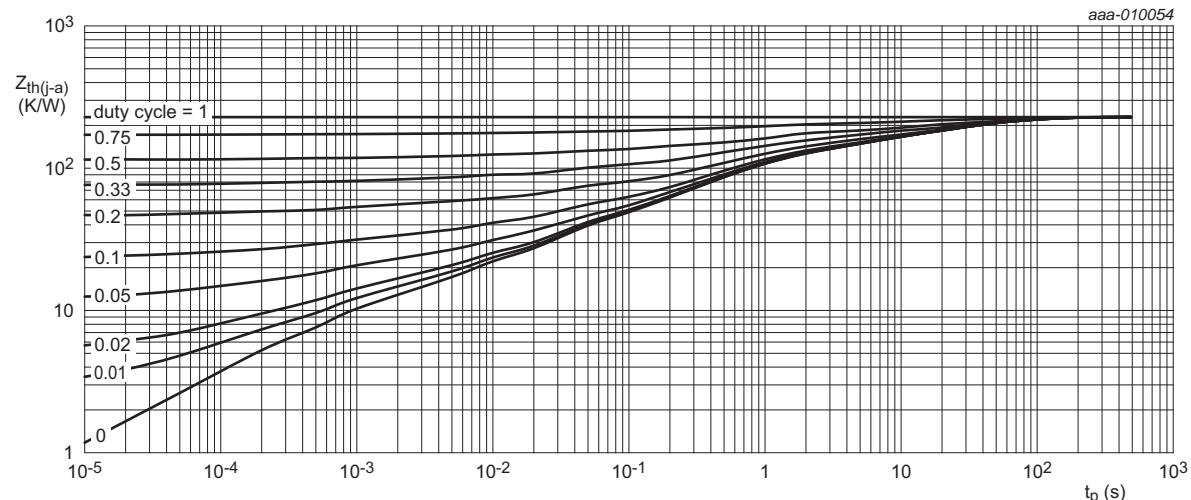
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1] -	-	265	K/W
			[2] -	-	190	K/W
			[3] -	-	165	K/W
			[4] -	-	115	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point	in free air	-	-	50	K/W

[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>.

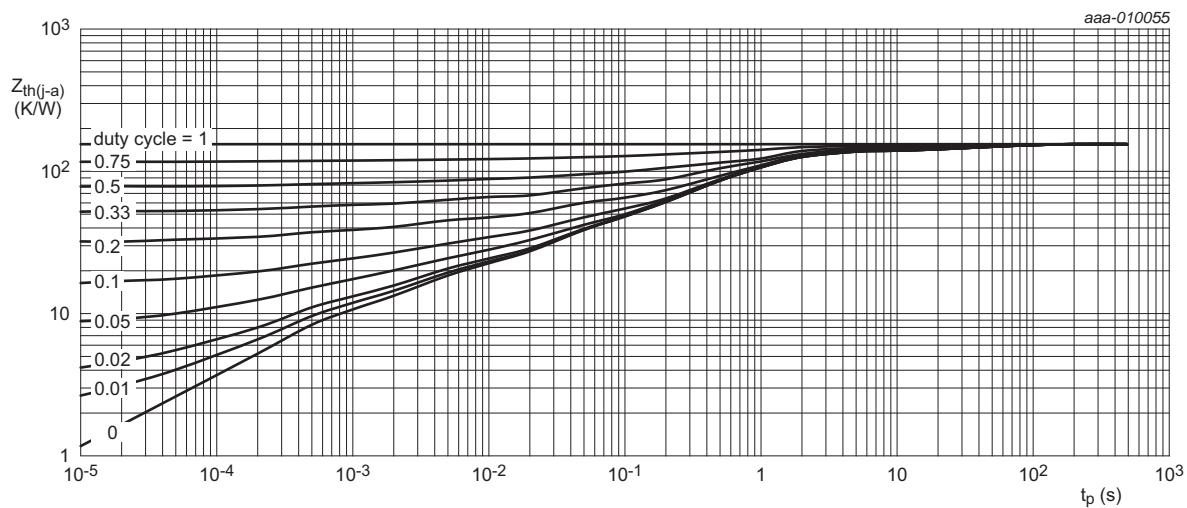
[3] Device mounted on an FR4 PCB; 4-layer copper; tin-plated and standard footprint.

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



FR4 PCB, single-sided copper, standard footprint

**Fig 2. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values**



FR4 PCB, 4-layer copper, standard footprint

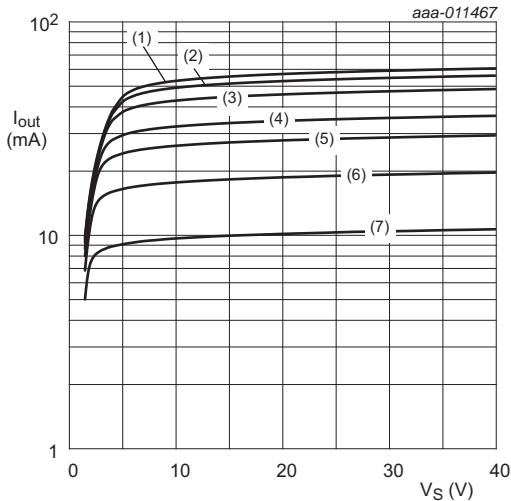
**Fig 3. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values**

## 7. Characteristics

**Table 7. Characteristics**

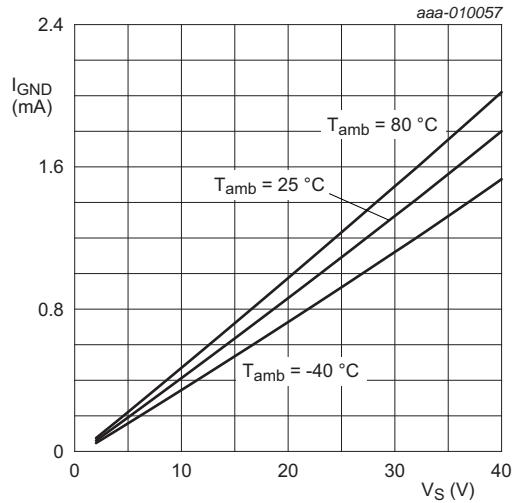
$T_{amb} = 25^\circ\text{C}$ ; pulse test:  $t_P \leq 300\ \mu\text{s}$ ;  $\delta = 0.02$ ; unless otherwise specified.

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	$V_S = 10\text{ V}$ ; $V_S - V_{out} = 1.4\text{ V}$	-	0.8	-	%/V

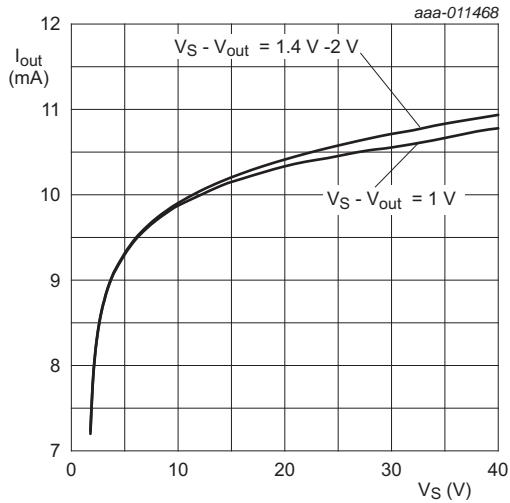


- (1)  $R_{ext} = 15\ \Omega$
- (2)  $R_{ext} = 18\ \Omega$
- (3)  $R_{ext} = 22\ \Omega$
- (4)  $R_{ext} = 33\ \Omega$
- (5)  $R_{ext} = 47\ \Omega$
- (6)  $R_{ext} = 100\ \Omega$
- (7)  $R_{ext} = \text{open}$

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

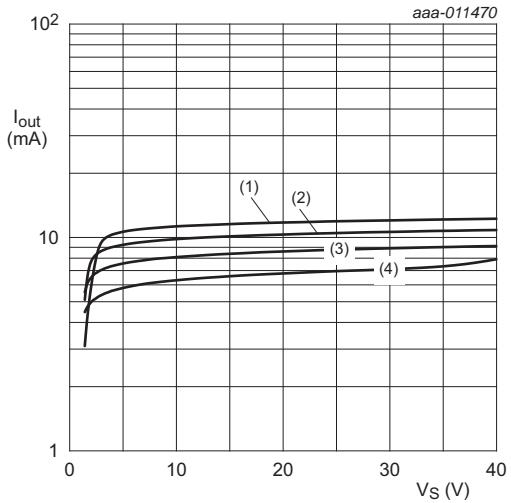


**Fig 5. Ground current as a function of supply voltage; typical values**



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

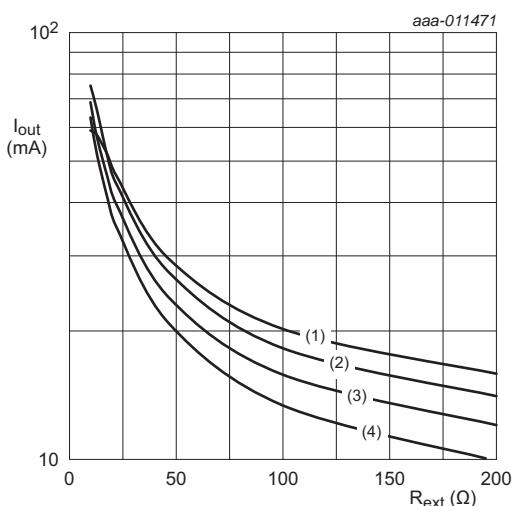
**Fig 6. Output current as a function of supply voltage; typical values**



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

- (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**



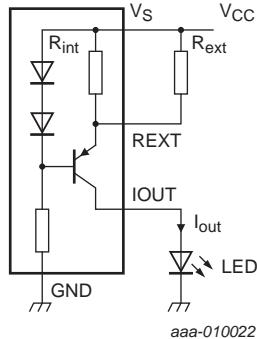
$V_S = 10 \text{ V}; V_{out} = 8.6 \text{ V}$

- (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**

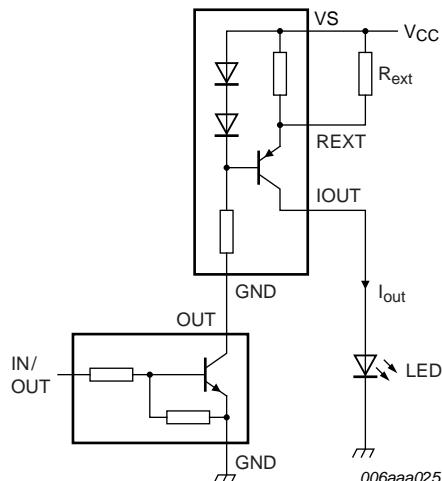
## 8. Application information

[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

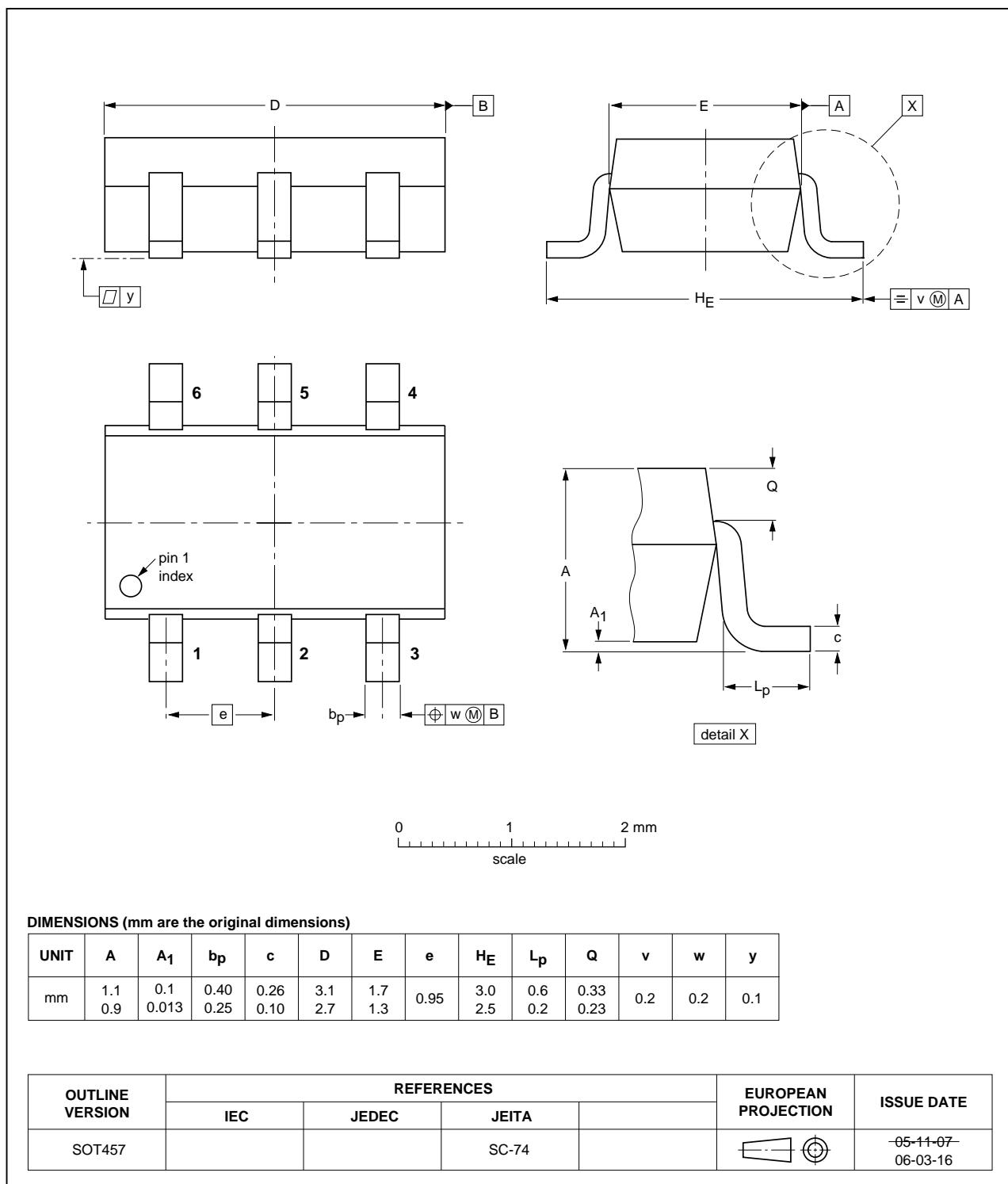


Fig 11. Package outline SOT457 (SC-74)

## 11. Soldering

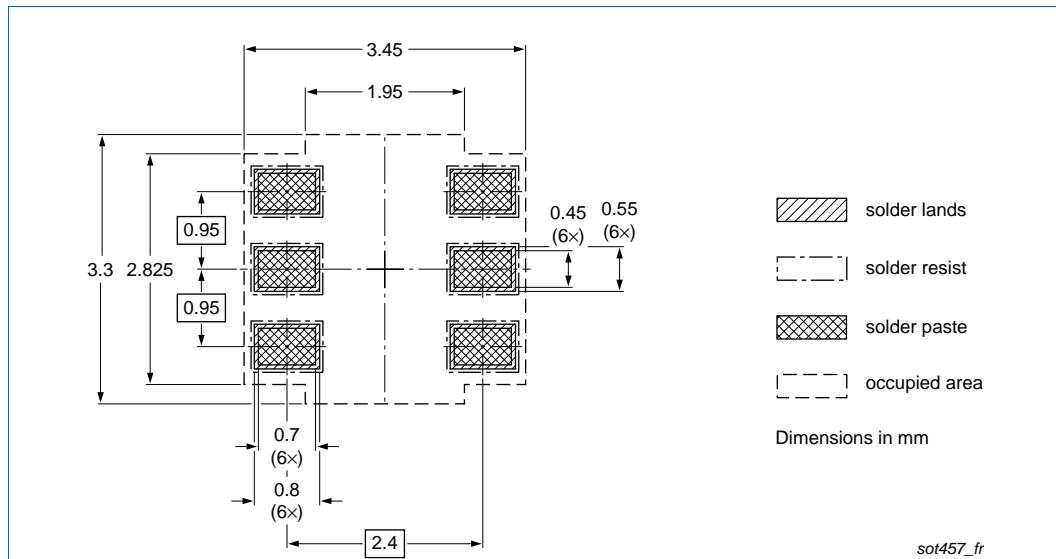


Fig 12. Reflow soldering footprint for SOT457 (SC-74)

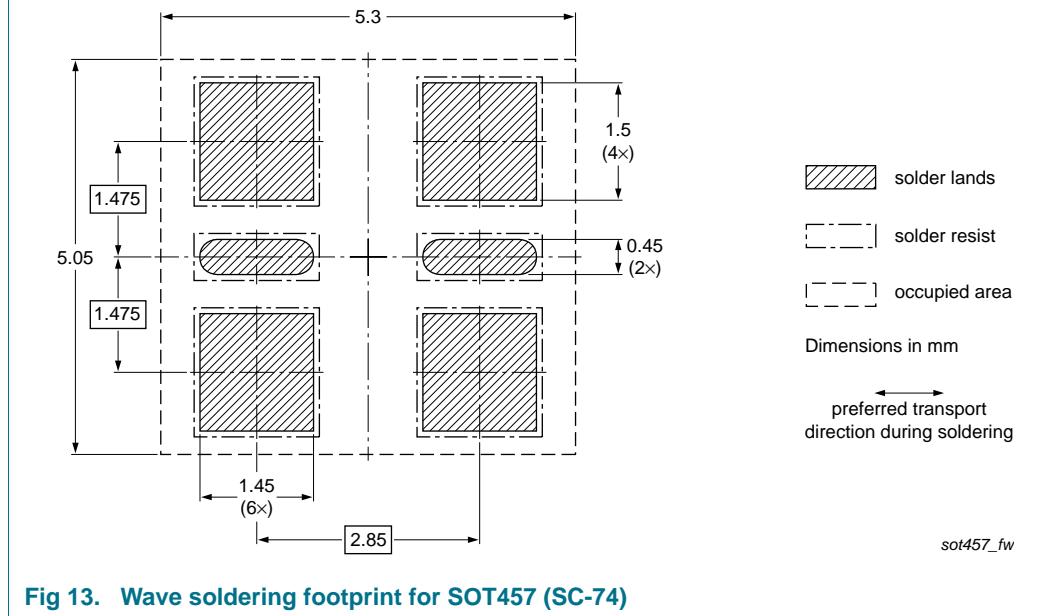


Fig 13. Wave soldering footprint for SOT457 (SC-74)

## 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.
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