



**THE DATASHEET OF  
PHPT61002NYCLHX**





# PHPT61002NYCLH

100 V, 2 A NPN high power bipolar transistor

24 March 2023

Product data sheet

## 1. General description

NPN high power bipolar transistor in a SOT669 (LFAK56) Surface-Mounted Device (SMD) power plastic package.

PNP complement: PHPT61002PYCLH

## 2. Features and benefits

- High thermal power dissipation capability
- High temperature applications up to 175 °C
- Reduced Printed Circuit Board (PCB) requirements comparing to transistors in DPAK
- High energy efficiency due to less heat generation

## 3. Applications

- Load switch
- Power management
- Linear mode voltage regulator
- Backlighting applications

## 4. Quick reference data

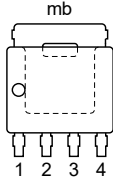
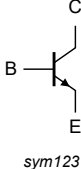
Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CEO}$	collector-emitter voltage	open base	-	-	100	V
$I_C$	collector current		-	-	2	A
$I_{CM}$	peak collector current	single pulse; $t_p \leq 1$ ms	-	-	6	A
$R_{CEsat}$	collector-emitter saturation resistance	$I_C = 2$ A; $I_B = 200$ mA; $T_{amb} = 25$ °C	[1]	80	150	mΩ

[1] pulsed;  $t_p \leq 300$  μs;  $\delta \leq 0.02$

## 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	E	emitter	 <p>LFPAK56; Power-SO8 (SOT669)</p>	 <p>sym123</p>
2	E	emitter		
3	E	emitter		
4	B	base		
mb	C	collector		

## 6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
<a href="#">PHPT61002NYCLH</a>	LFPAK56; Power-SO8	plastic, single-ended surface-mounted package; 4 terminals	<a href="#">SOT669</a>

## 7. Marking

Table 4. Marking codes

Type number	Marking code
PHPT61002NYCLH	1002NCC

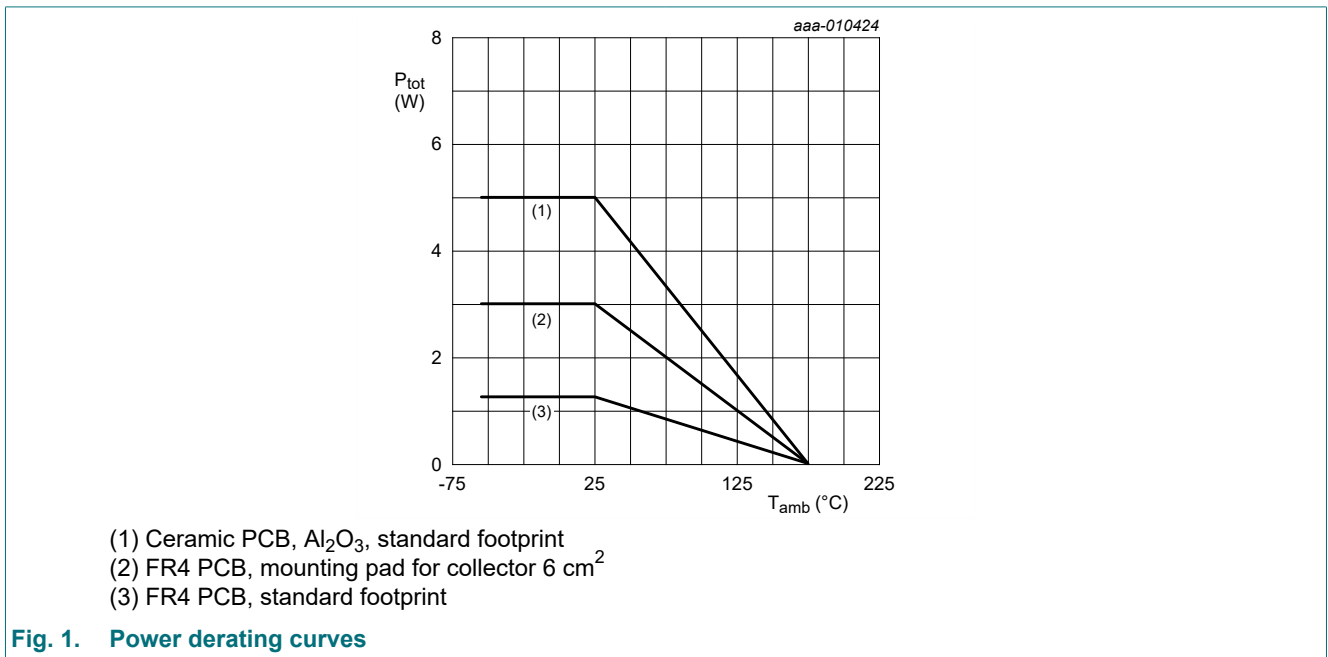
## 8. Limiting values

**Table 5. Limiting values**

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

Symbol	Parameter	Conditions		Min	Max	Unit
$V_{CBO}$	collector-base voltage	open emitter		-	100	V
$V_{CEO}$	collector-emitter voltage	open base		-	100	V
$V_{EBO}$	emitter-base voltage	open collector		-	7	V
$I_C$	collector current			-	2	A
$I_{CM}$	peak collector current	single pulse; $t_p \leq 1$ ms		-	6	A
$I_B$	base current			-	0.5	A
$P_{tot}$	total power dissipation	$T_{amb} \leq 25$ °C	[1]	-	1.25	W
			[2]	-	3	W
			[3]	-	5	W
			[4]	-	25	W
$T_j$	junction temperature			-	175	°C
$T_{amb}$	ambient temperature			-55	175	°C
$T_{stg}$	storage temperature			-65	175	°C

- [1] Device mounted on an FR4 Printed-Circuit Board (PCB); single-sided copper; tin-plated and standard footprint.
- [2] Device mounted on an FR4 PCB; single-sided copper; tin-plated mounting pad for collector 6 cm<sup>2</sup>.
- [3] Device mounted on an ceramic PCB; Al<sub>2</sub>O<sub>3</sub>; standard footprint.
- [4] Power dissipation from junction to mounting base.



**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]	-	-	115	K/W
			[2]	-	-	50	K/W
			[3]	-	-	30	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point			-	-	6	K/W

[1] Device mounted on an FR4 Printed-Circuit Board (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 6 cm<sup>2</sup>.

[3] Device mounted on an ceramic PCB, Al<sub>2</sub>O<sub>3</sub>, standard footprint.

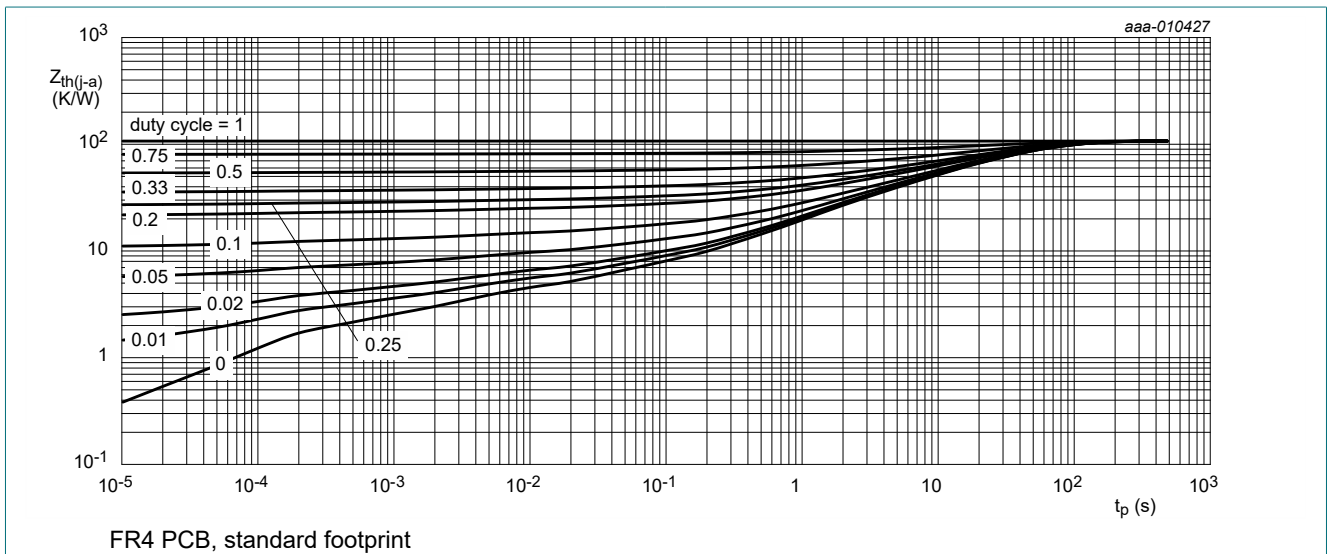


Fig. 2. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

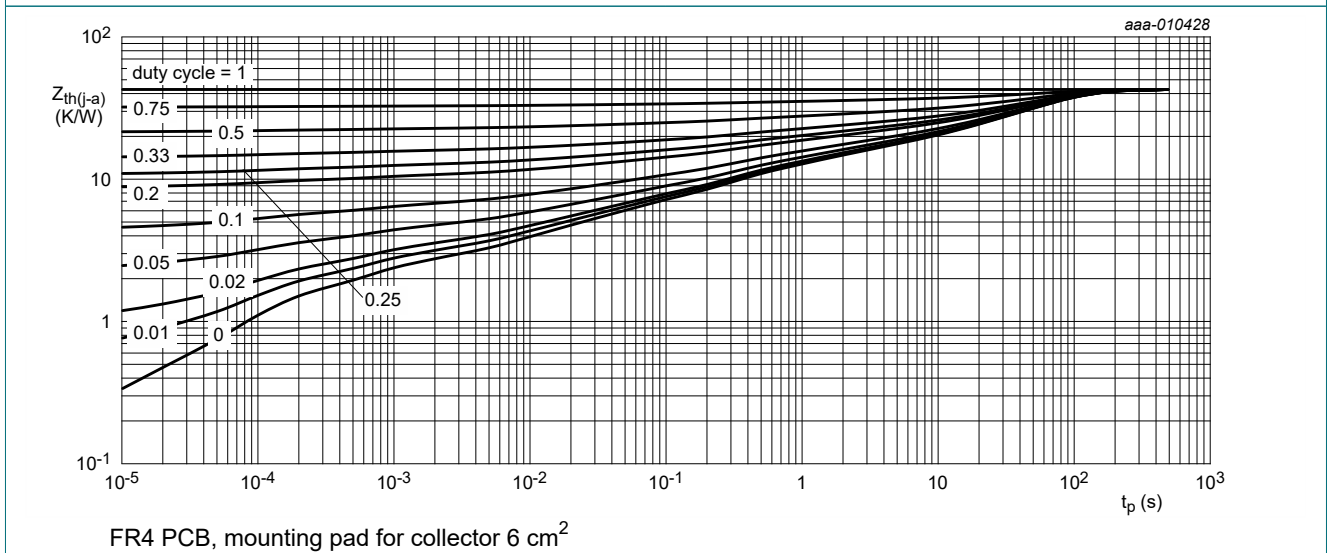


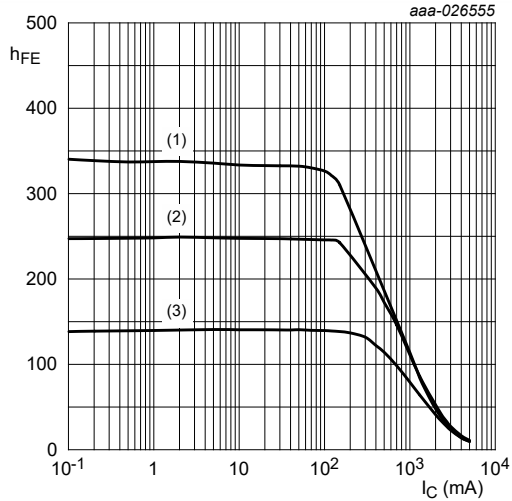
Fig. 3. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

## 10. Characteristics

Table 7. Characteristics

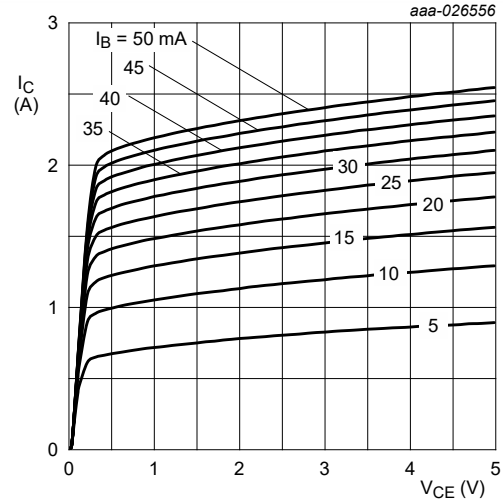
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$I_{CBO}$	collector-base cut-off current	$V_{CB} = 80 \text{ V}; I_E = 0 \text{ A}; T_{amb} = 25 \text{ }^\circ\text{C}$		-	-	100	nA
		$V_{CB} = 80 \text{ V}; I_E = 0 \text{ A}; T_j = 150 \text{ }^\circ\text{C}$		-	-	50	$\mu\text{A}$
$I_{EBO}$	emitter-base cut-off current	$V_{EB} = 7 \text{ V}; I_C = 0 \text{ A}; T_{amb} = 25 \text{ }^\circ\text{C}$		-	-	100	nA
$I_{CES}$	collector-emitter cut-off current	$V_{CE} = 80 \text{ V}; V_{BE} = 0 \text{ V}; T_{amb} = 25 \text{ }^\circ\text{C}$		-	-	100	nA
$h_{FE}$	DC current gain	$V_{CE} = 1.5 \text{ V}; I_C = 500 \text{ mA}; T_{amb} = 25 \text{ }^\circ\text{C}$	[1]	100	180	-	
		$V_{CE} = 10 \text{ V}; I_C = 500 \text{ mA}; T_{amb} = 25 \text{ }^\circ\text{C}$	[1]	120	220	-	
		$V_{CE} = 5 \text{ V}; I_C = 1 \text{ A}; T_{amb} = 25 \text{ }^\circ\text{C}$	[1]	90	160	260	
		$V_{CE} = 10 \text{ V}; I_C = 1 \text{ A}; T_{amb} = 25 \text{ }^\circ\text{C}$	[1]	90	180	-	
		$V_{CE} = 10 \text{ V}; I_C = 2 \text{ A}; T_{amb} = 25 \text{ }^\circ\text{C}$	[1]	20	80	-	
$V_{CEsat}$	collector-emitter saturation voltage	$I_C = 0.5 \text{ A}; I_B = 50 \text{ mA}; T_{amb} = 25 \text{ }^\circ\text{C}$		-	50	75	mV
		$I_C = 2 \text{ A}; I_B = 200 \text{ mA}; T_{amb} = 25 \text{ }^\circ\text{C}$	[1]	-	160	300	mV
$R_{CEsat}$	collector-emitter saturation resistance		[1]	-	80	150	m $\Omega$
$V_{BEsat}$	base-emitter saturation voltage	$I_C = 1 \text{ A}; I_B = 50 \text{ mA}; T_{amb} = 25 \text{ }^\circ\text{C}$	[1]	-	0.92	1.05	V
		$I_C = 2 \text{ A}; I_B = 200 \text{ mA}; T_{amb} = 25 \text{ }^\circ\text{C}$	[1]	-	1.08	1.2	V
$V_{BEon}$	base-emitter turn-on voltage	$V_{CE} = 2 \text{ V}; I_C = 0.1 \text{ A}; T_{amb} = 25 \text{ }^\circ\text{C}$		-	0.68	0.85	V
$t_d$	delay time	$V_{CC} = 12.5 \text{ V}; I_C = 1 \text{ A}; I_{Bon} = 0.05 \text{ A}; I_{Boff} = -0.05 \text{ A}; T_{amb} = 25 \text{ }^\circ\text{C}$		-	20	-	ns
$t_r$	rise time			-	300	-	ns
$t_{on}$	turn-on time			-	320	-	ns
$t_s$	storage time			-	800	-	ns
$t_f$	fall time			-	420	-	ns
$t_{off}$	turn-off time			-	1220	-	ns
$f_T$	transition frequency		$V_{CE} = 10 \text{ V}; I_C = 100 \text{ mA}; f = 100 \text{ MHz}; T_{amb} = 25 \text{ }^\circ\text{C}$		-	140	-
$C_c$	collector capacitance	$V_{CB} = 10 \text{ V}; I_E = 0 \text{ A}; i_e = 0 \text{ A}; f = 1 \text{ MHz}; T_{amb} = 25 \text{ }^\circ\text{C}$		-	11	-	pF

[1] pulsed;  $t_p \leq 300 \mu\text{s}$ ;  $\delta \leq 0.02$



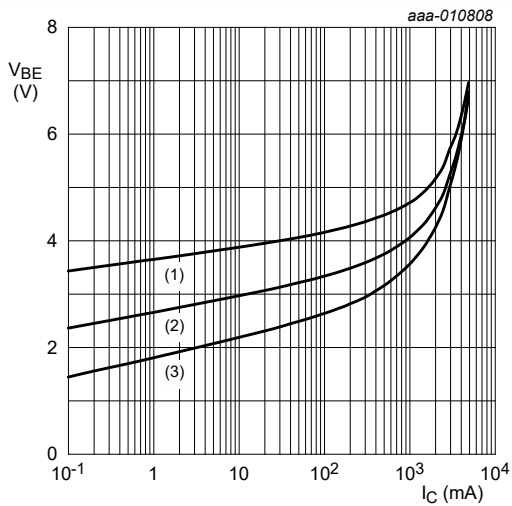
$V_{CE} = 1\text{ V}$   
 (1)  $T_{amb} = 100\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = -55\text{ °C}$

**Fig. 4. DC current gain as a function of collector current; typical values**



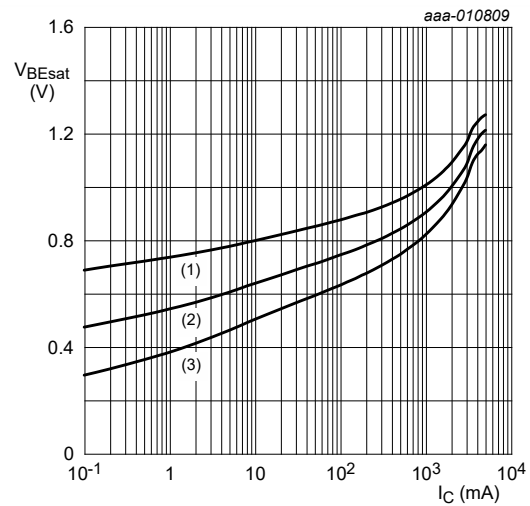
$T_{amb} = 25\text{ °C}$

**Fig. 5. Collector current as a function of collector-emitter voltage; typical values**



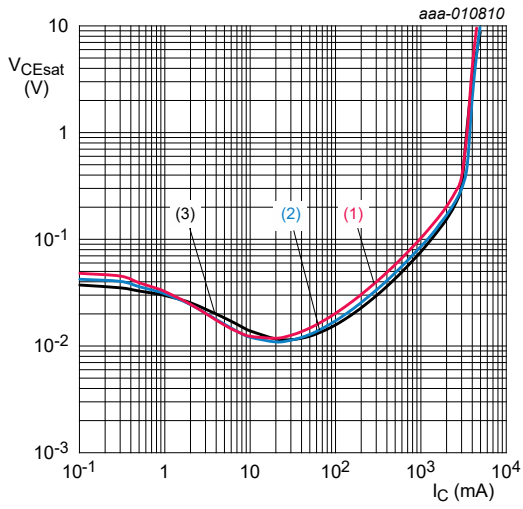
$V_{CE} = 2\text{ V}$   
 (1)  $T_{amb} = -55\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = 100\text{ °C}$

**Fig. 6. Base-emitter voltage as a function of collector current; typical values**



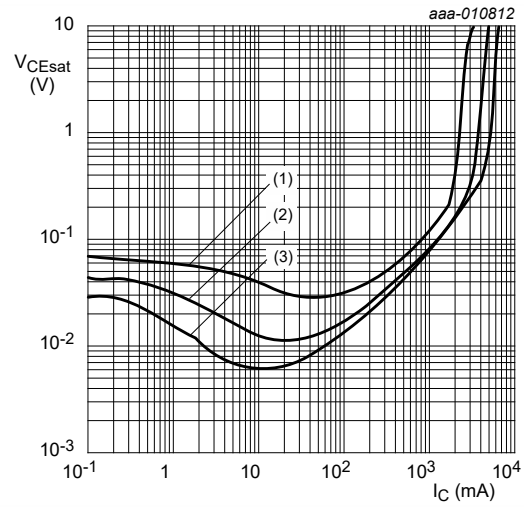
$I_C/I_B = 20$   
 (1)  $T_{amb} = -55\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = 100\text{ °C}$

**Fig. 7. Base-emitter saturation voltage as a function of collector current; typical values**



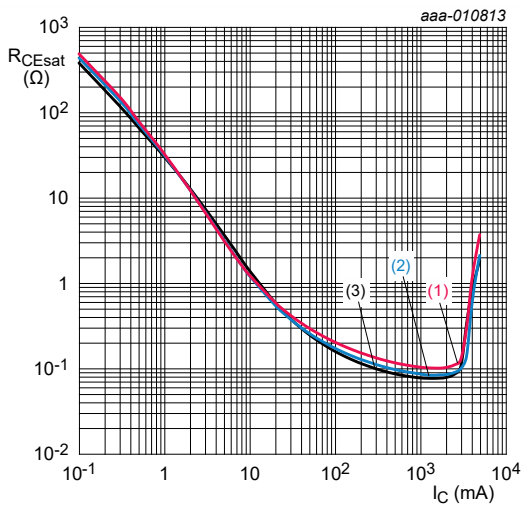
$I_C/I_B = 20$   
 (1)  $T_{amb} = 100\text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25\text{ }^\circ\text{C}$   
 (3)  $T_{amb} = -55\text{ }^\circ\text{C}$

Fig. 8. Collector-emitter saturation voltage as a function of collector current; typical values



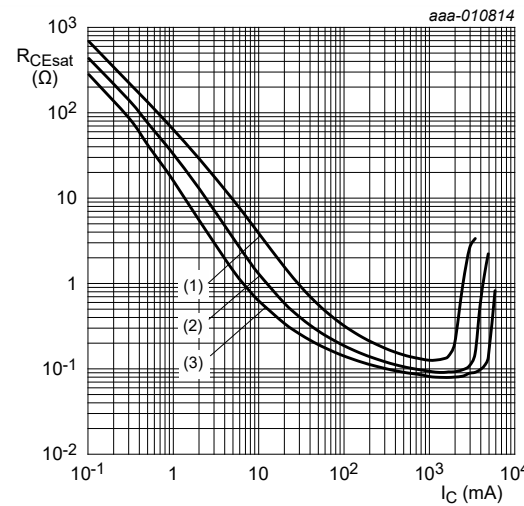
$T_{amb} = 25\text{ }^\circ\text{C}$   
 (1)  $I_C/I_B = 50$   
 (2)  $I_C/I_B = 20$   
 (3)  $I_C/I_B = 10$

Fig. 9. Collector-emitter saturation voltage as a function of collector current; typical values



$I_C/I_B = 20$   
 (1)  $T_{amb} = 100\text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25\text{ }^\circ\text{C}$   
 (3)  $T_{amb} = -55\text{ }^\circ\text{C}$

Fig. 10. Collector-emitter saturation resistance as a function of collector current; typical values



$T_{amb} = 25\text{ }^\circ\text{C}$   
 (1)  $I_C/I_B = 50$   
 (2)  $I_C/I_B = 20$   
 (3)  $I_C/I_B = 10$

Fig. 11. Collector-emitter saturation resistance as a function of collector current; typical values

11. Test information

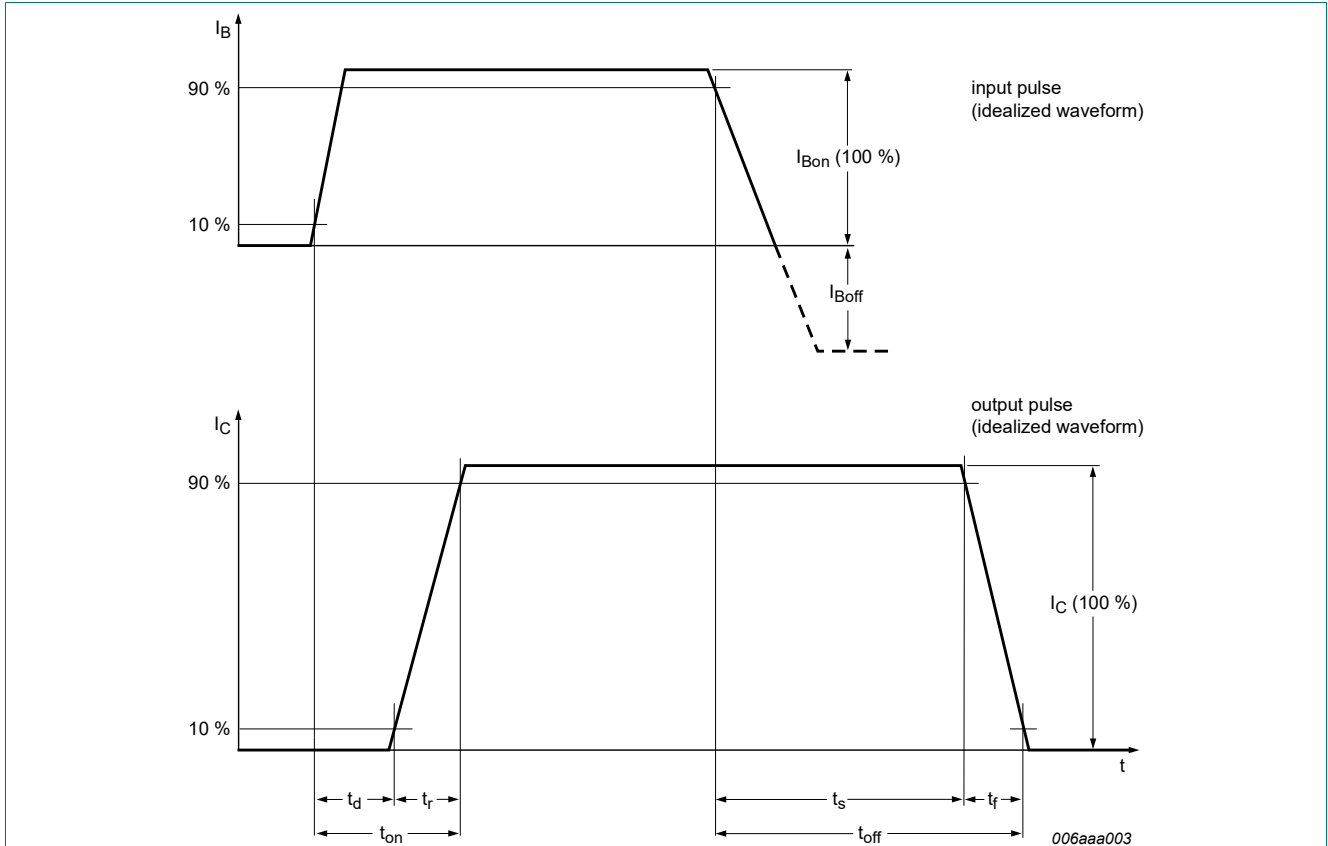


Fig. 12. Switching time definition

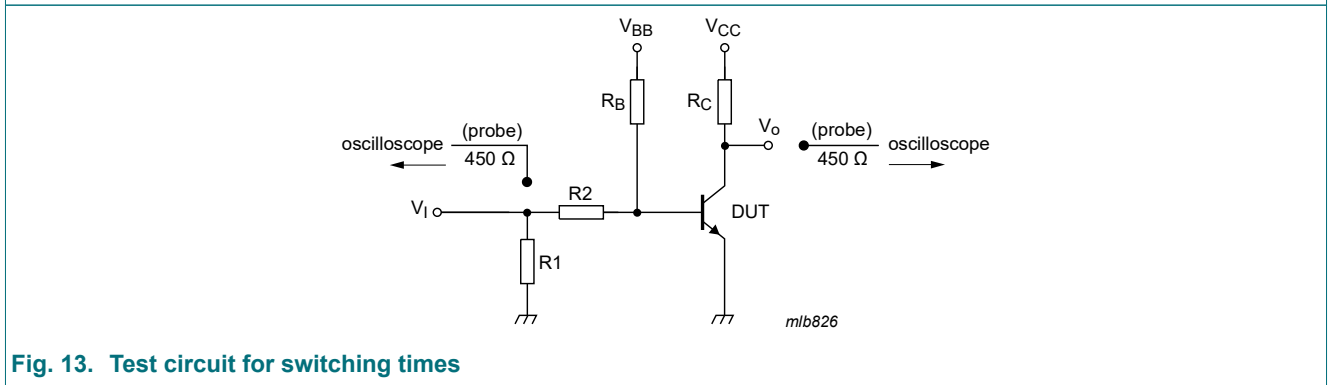


Fig. 13. Test circuit for switching times

12. Package outline

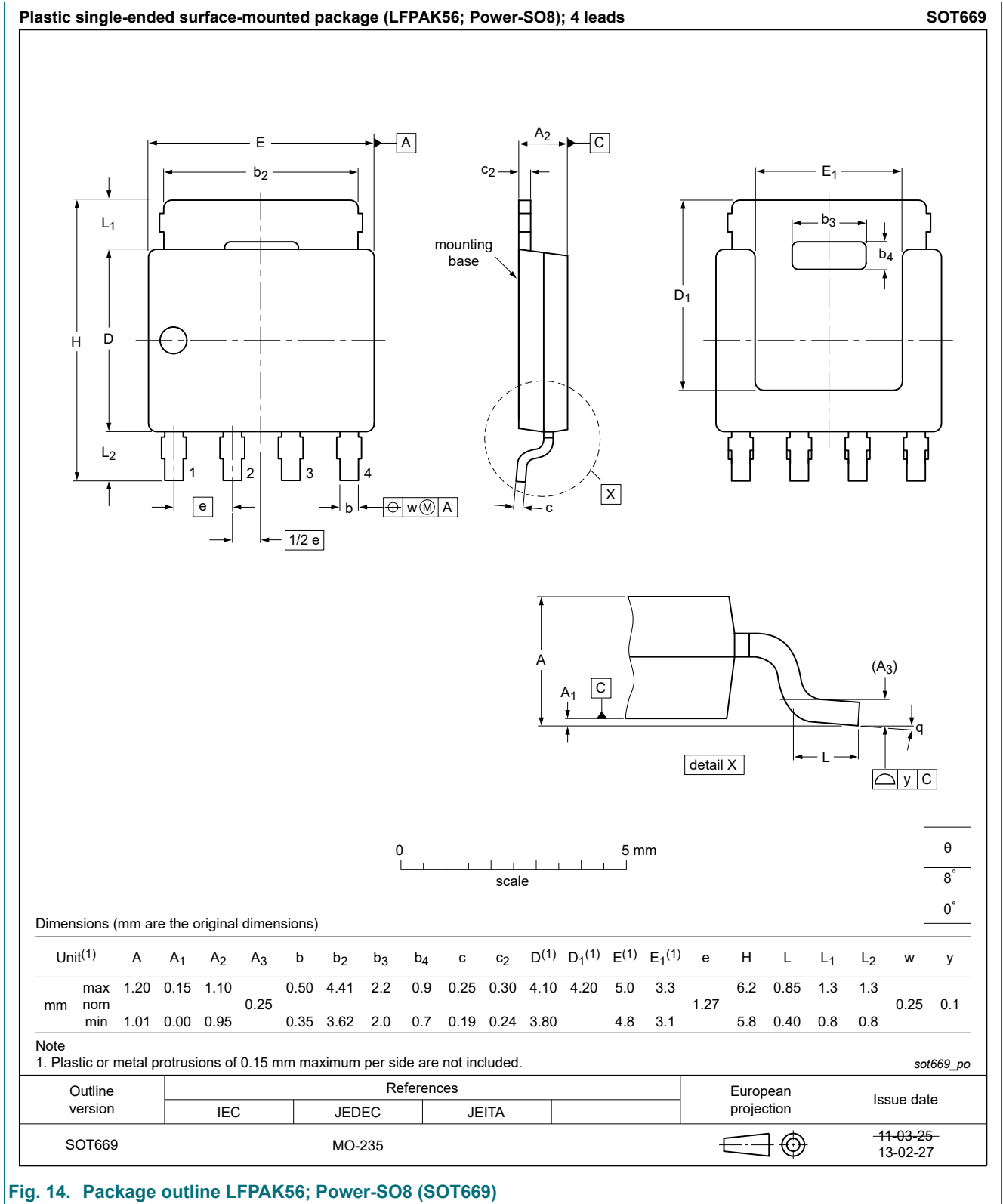


Fig. 14. Package outline LFAK56; Power-SO8 (SOT669)

### 13. Soldering

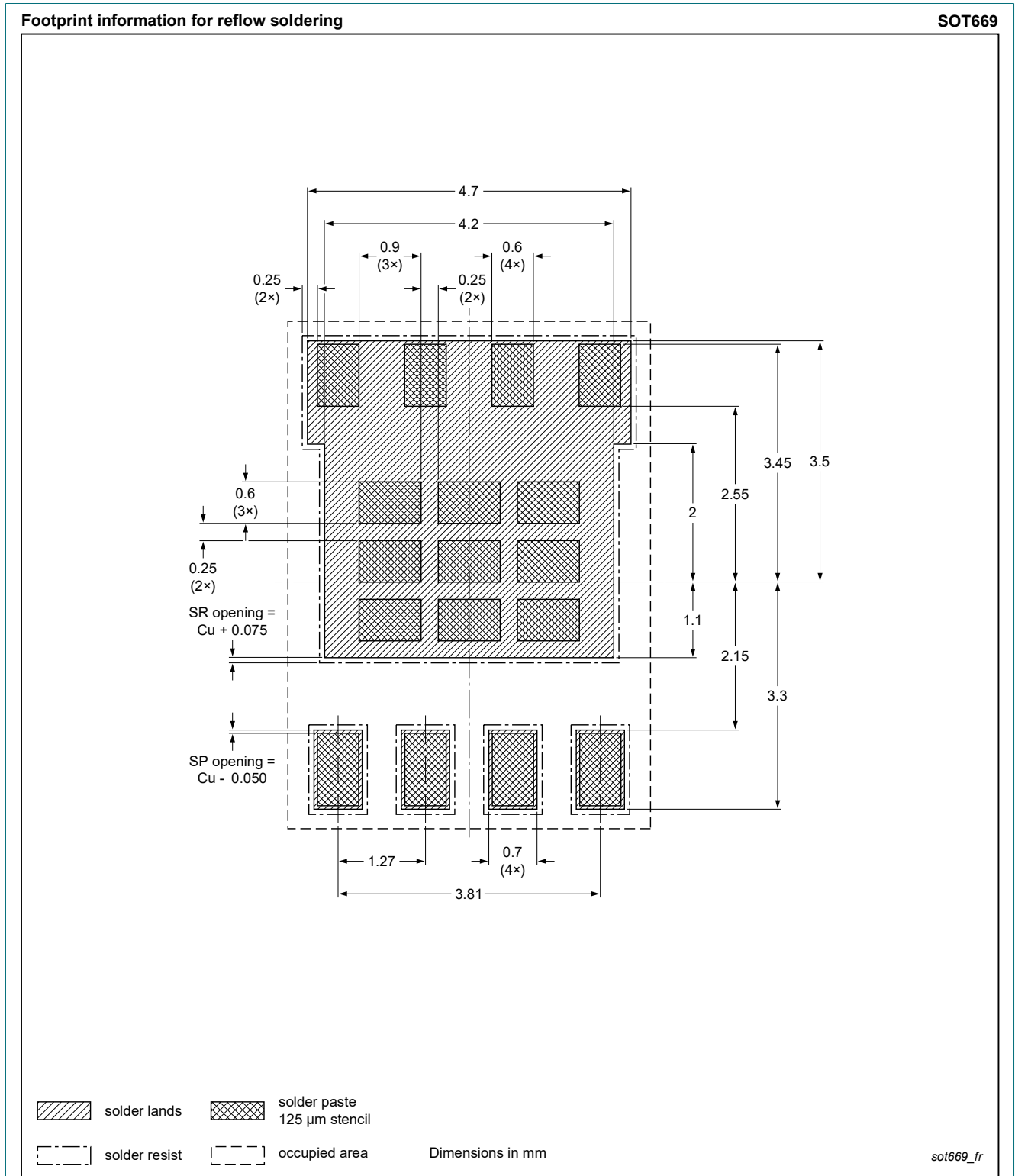
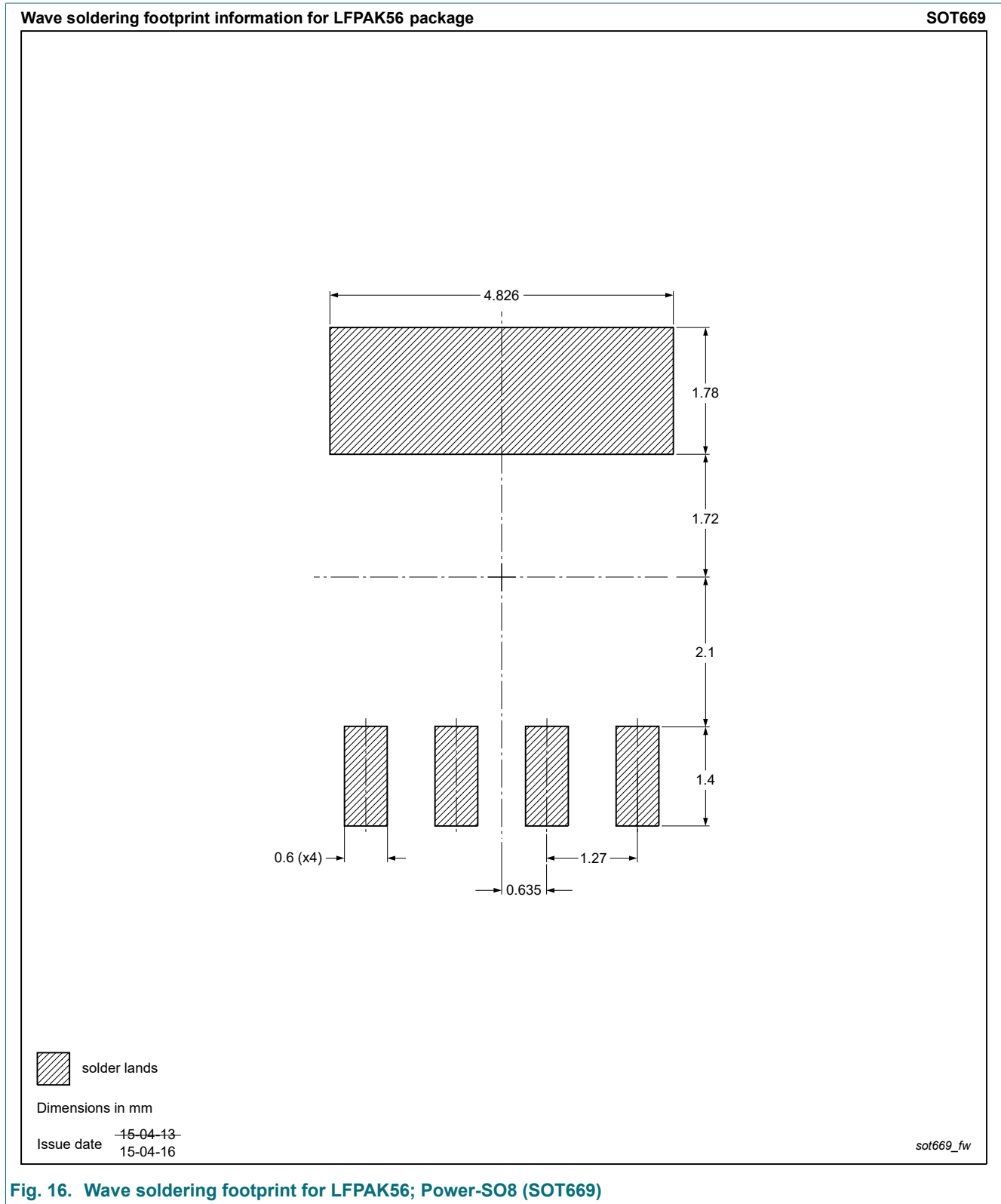


Fig. 15. Reflow soldering footprint for LFPK56; Power-SO8 (SOT669)



## 14. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PHPT61002NYCLH v.2	20230324	Product data sheet	-	PHPT61002NYCLH v.1
Modifications:	• Test information corrected			
PHPT61002NYCLH v.1	20170331	Product data sheet	-	-

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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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## Contents

---

1. General description.....	1
2. Features and benefits.....	1
3. Applications.....	1
4. Quick reference data.....	1
5. Pinning information.....	2
6. Ordering information.....	2
7. Marking.....	2
8. Limiting values.....	3
9. Thermal characteristics.....	4
10. Characteristics.....	5
11. Test information.....	8
12. Package outline.....	9
13. Soldering.....	10
14. Revision history.....	12
15. Legal information.....	13

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