



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

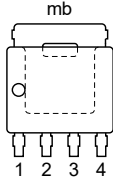
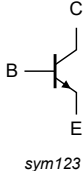
Table 1. Quick reference data

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
PHPT61002NYCLH	LFPAK56; Power-SO8	plastic, single-ended surface-mounted package; 4 terminals	SOT669

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 cm².
- [3] Device mounted on an ceramic PCB; Al₂O₃; standard footprint.
- [4] Power dissipation from junction to mounting base.

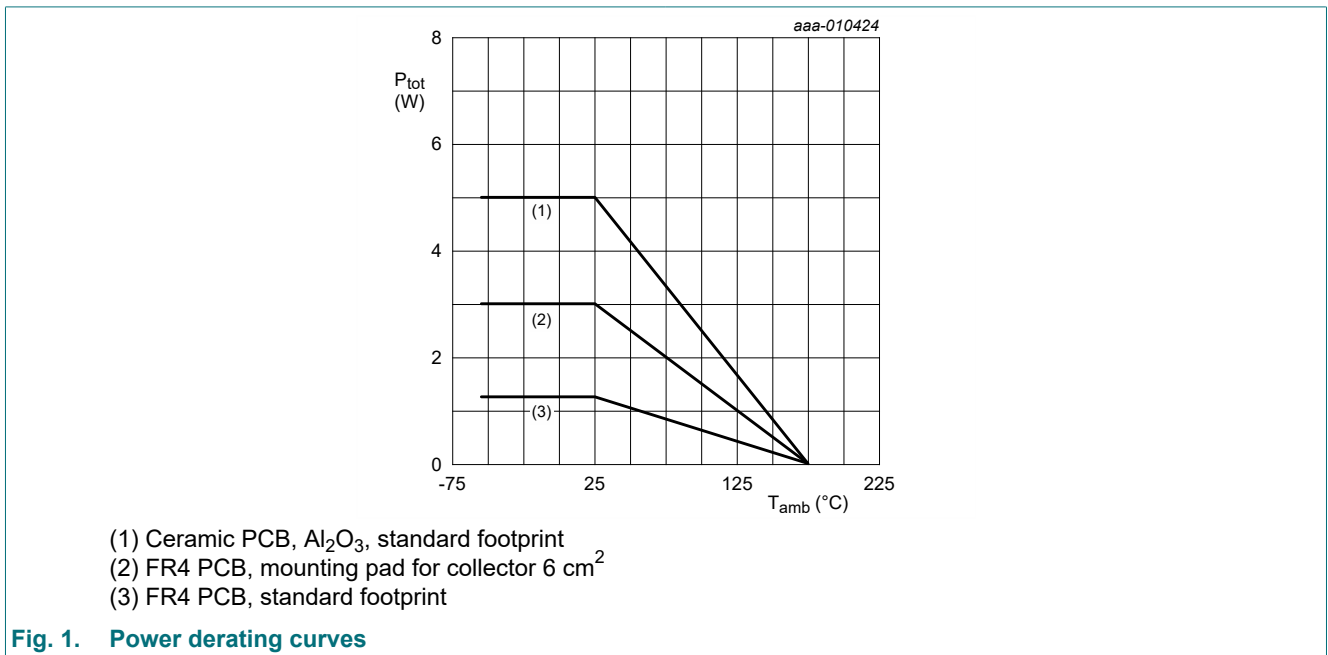


Fig. 1. Power derating curves

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 cm².

[3] Device mounted on a ceramic PCB, Al₂O₃, standard footprint.

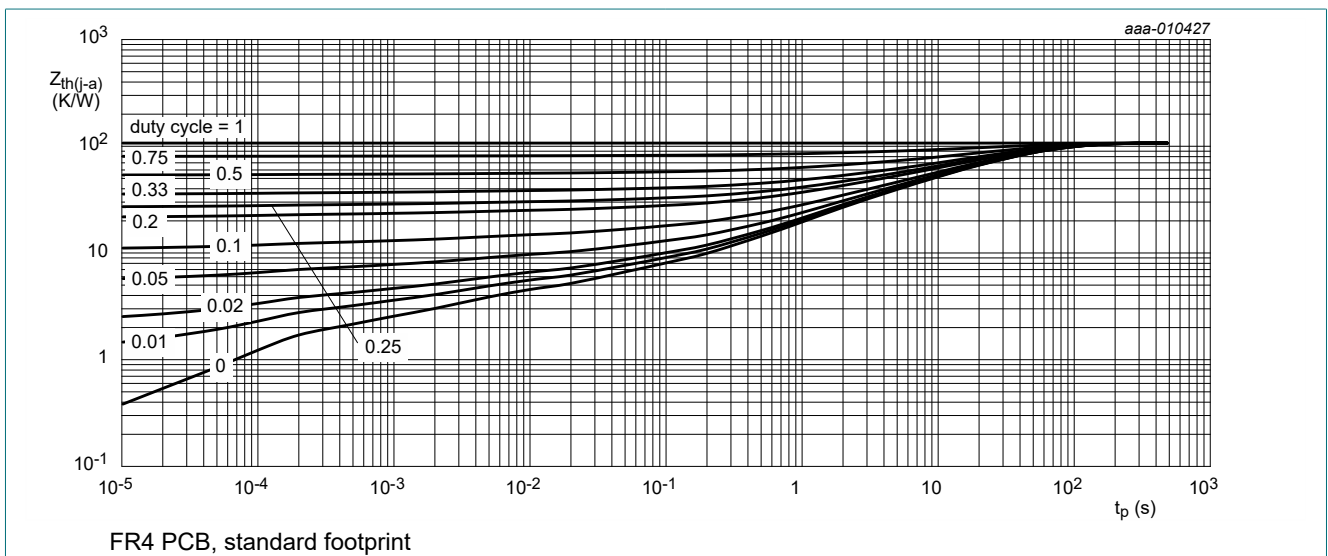


Fig. 2. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

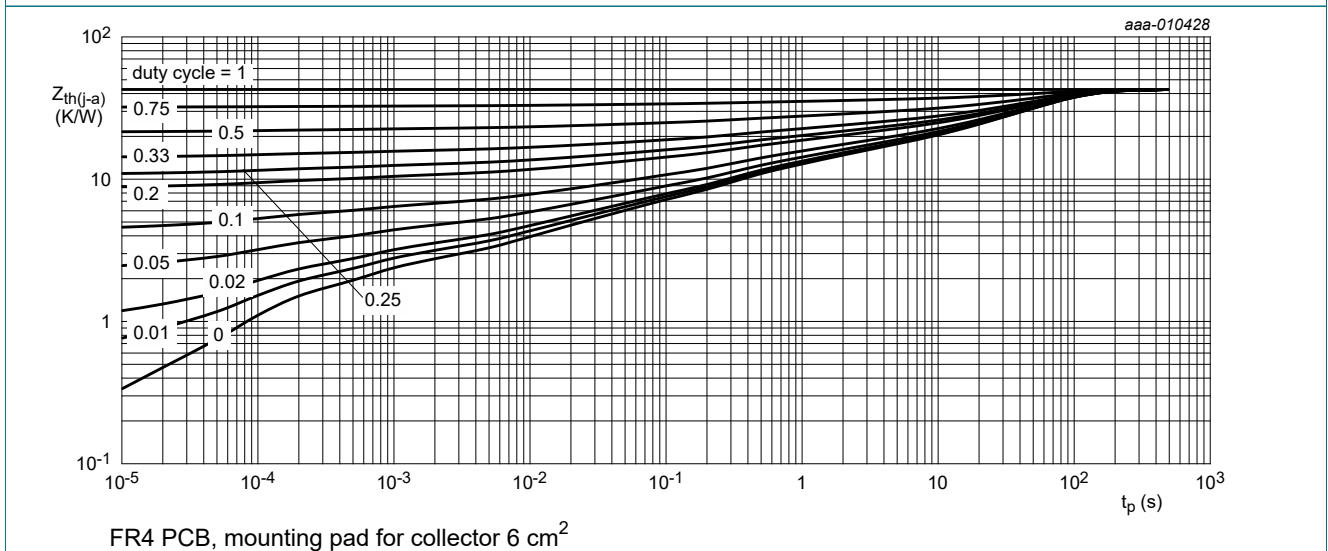


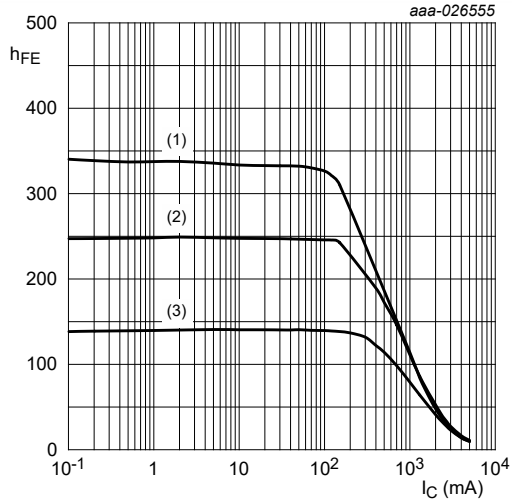
Fig. 3. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

10. Characteristics

Table 7. Characteristics

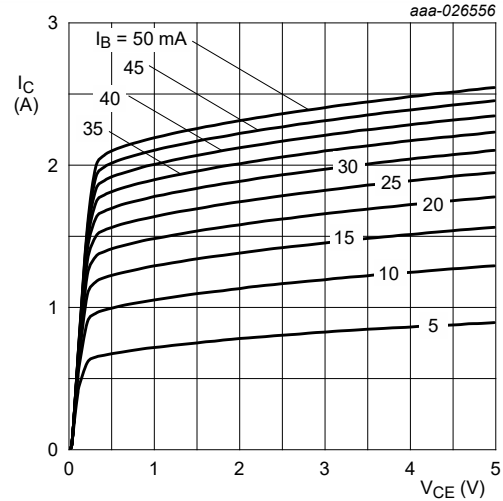
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
I_{CBO}	collector-base cut-off current	$V_{CB} = 80 \text{ V}; I_E = 0 \text{ A}; T_{amb} = 25 \text{ }^\circ\text{C}$		-	-	100	nA
		$V_{CB} = 80 \text{ V}; I_E = 0 \text{ A}; T_j = 150 \text{ }^\circ\text{C}$		-	-	50	μA
I_{EBO}	emitter-base cut-off current	$V_{EB} = 7 \text{ V}; I_C = 0 \text{ A}; T_{amb} = 25 \text{ }^\circ\text{C}$		-	-	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 Ω
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; $t_p \leq 300 \mu\text{s}$; $\delta \leq 0.02$



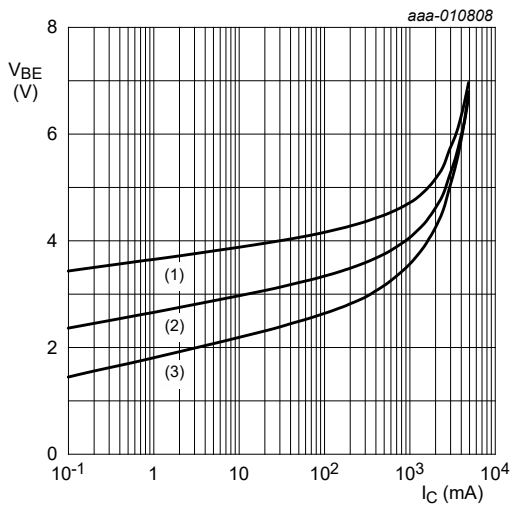
$V_{CE} = 1 \text{ V}$
 (1) $T_{amb} = 100 \text{ }^\circ\text{C}$
 (2) $T_{amb} = 25 \text{ }^\circ\text{C}$
 (3) $T_{amb} = -55 \text{ }^\circ\text{C}$

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



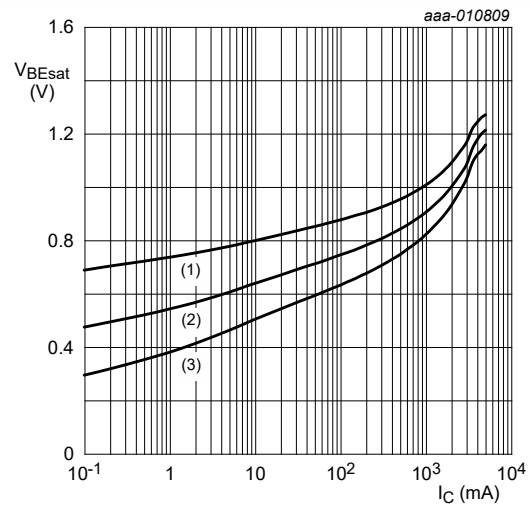
$T_{amb} = 25 \text{ }^\circ\text{C}$

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



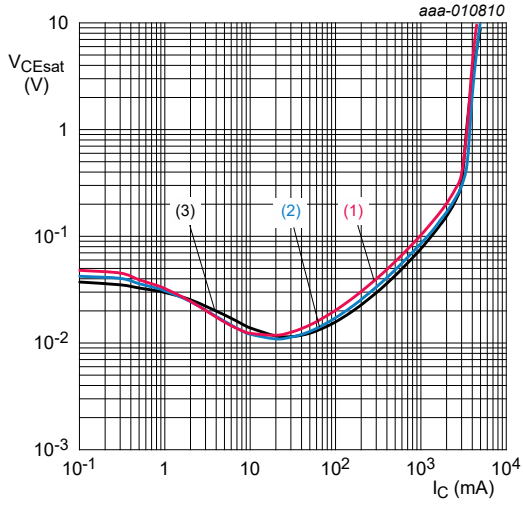
$V_{CE} = 2 \text{ V}$
 (1) $T_{amb} = -55 \text{ }^\circ\text{C}$
 (2) $T_{amb} = 25 \text{ }^\circ\text{C}$
 (3) $T_{amb} = 100 \text{ }^\circ\text{C}$

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



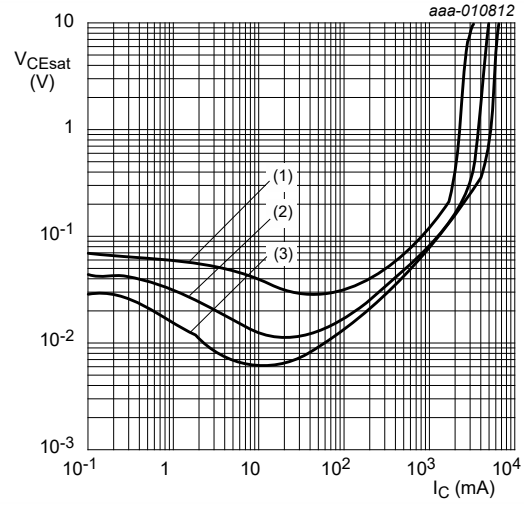
$I_C/I_B = 20$
 (1) $T_{amb} = -55 \text{ }^\circ\text{C}$
 (2) $T_{amb} = 25 \text{ }^\circ\text{C}$
 (3) $T_{amb} = 100 \text{ }^\circ\text{C}$

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



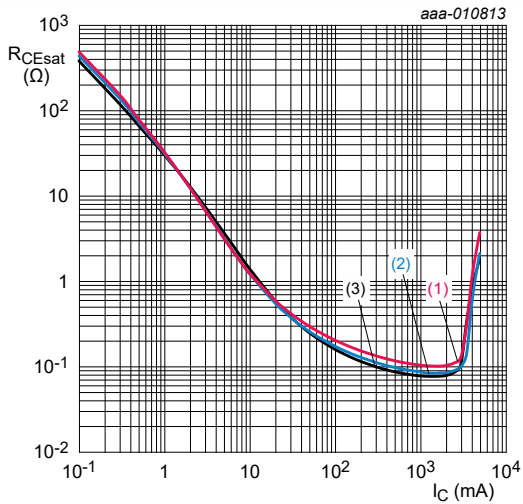
$I_C/I_B = 20$
 (1) $T_{amb} = 100\text{ }^\circ\text{C}$
 (2) $T_{amb} = 25\text{ }^\circ\text{C}$
 (3) $T_{amb} = -55\text{ }^\circ\text{C}$

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



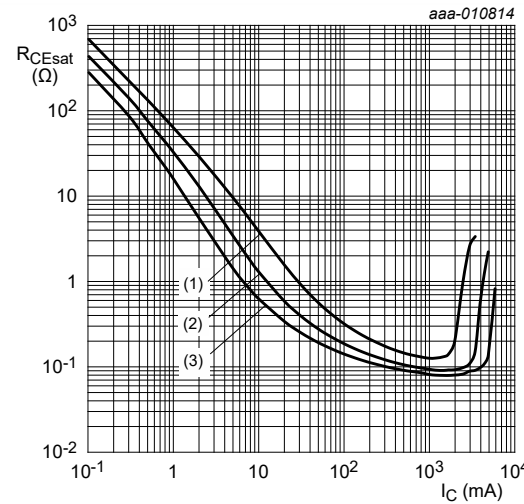
$T_{amb} = 25\text{ }^\circ\text{C}$
 (1) $I_C/I_B = 50$
 (2) $I_C/I_B = 20$
 (3) $I_C/I_B = 10$

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

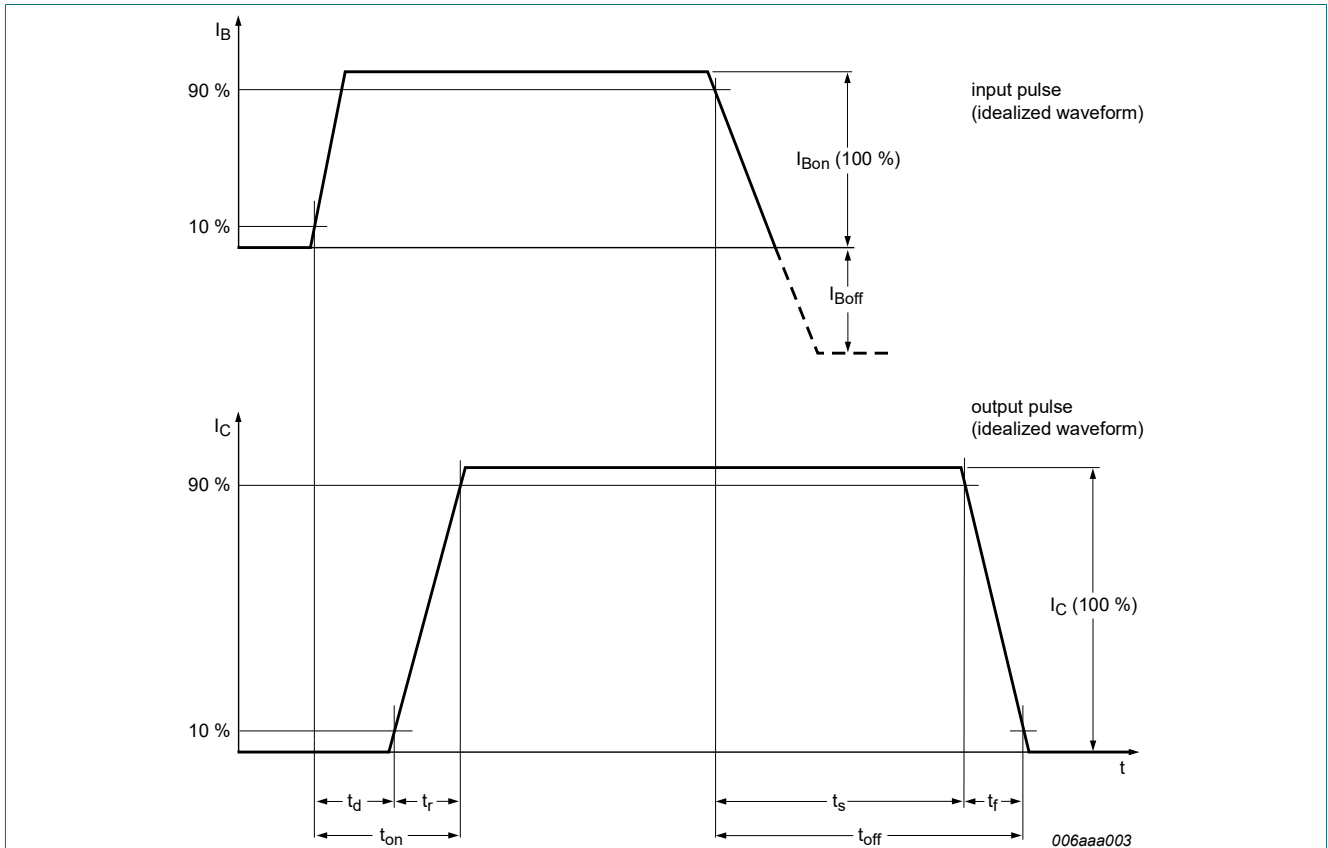


Fig. 12. Switching time definition

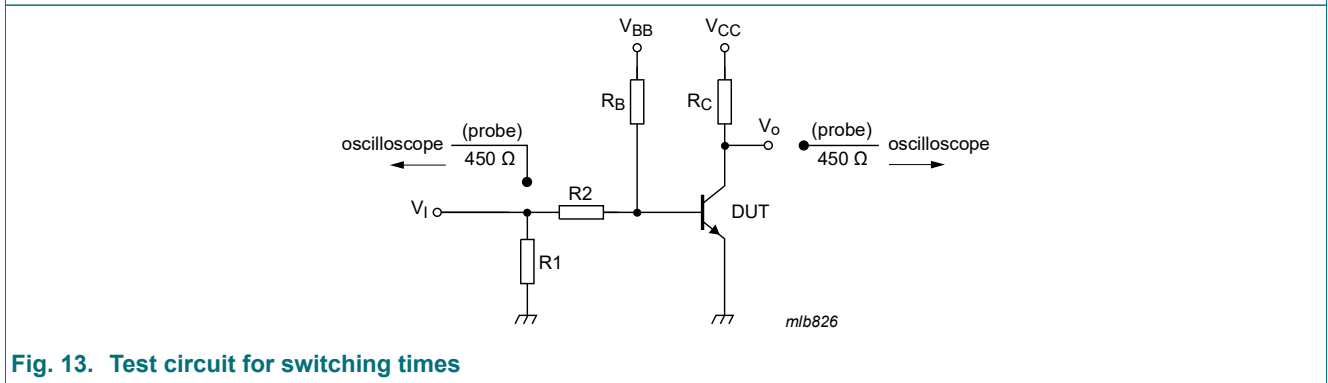


Fig. 13. Test circuit for switching times

12. Package outline

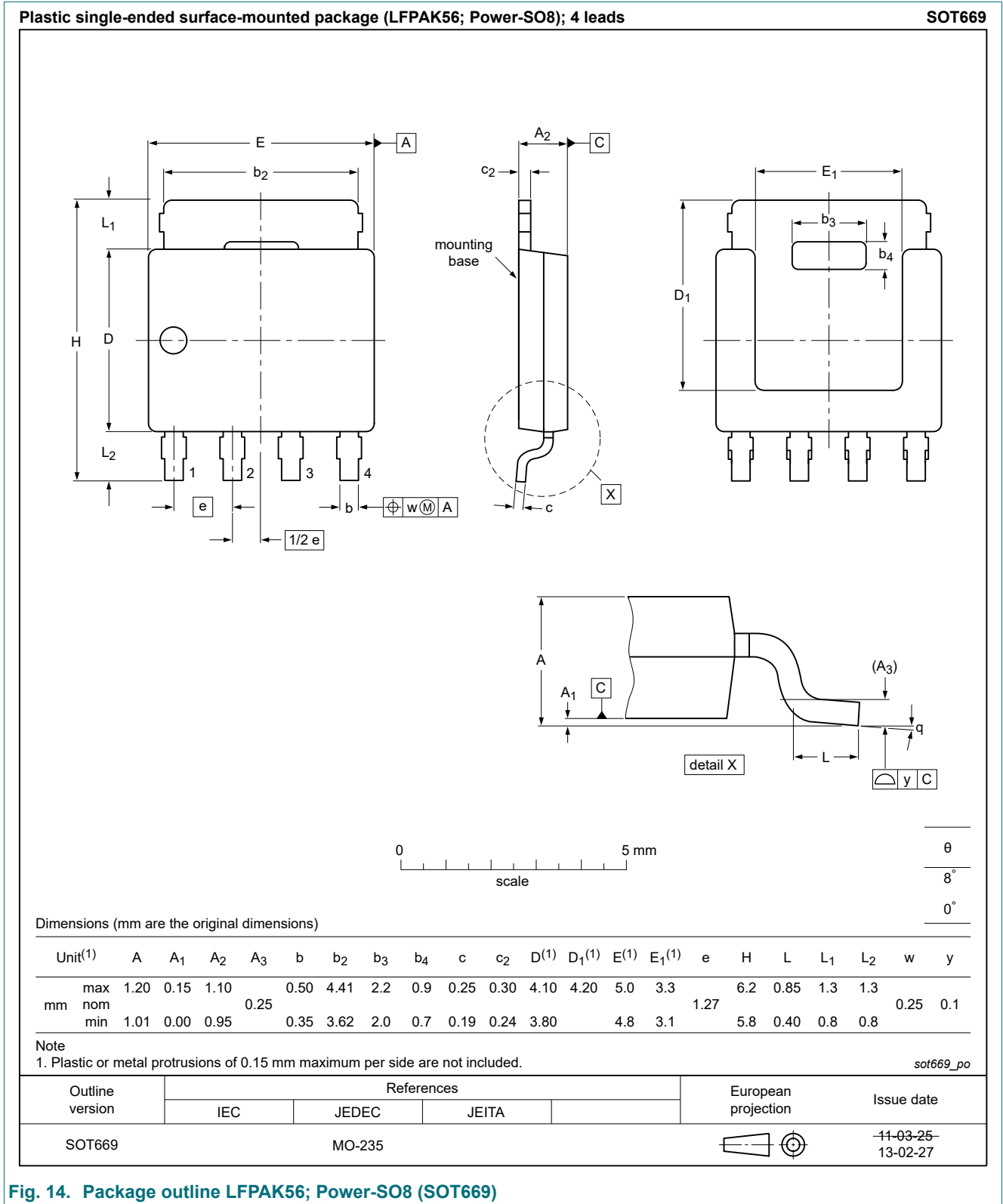


Fig. 14. Package outline LFAK56; Power-SO8 (SOT669)

13. Soldering

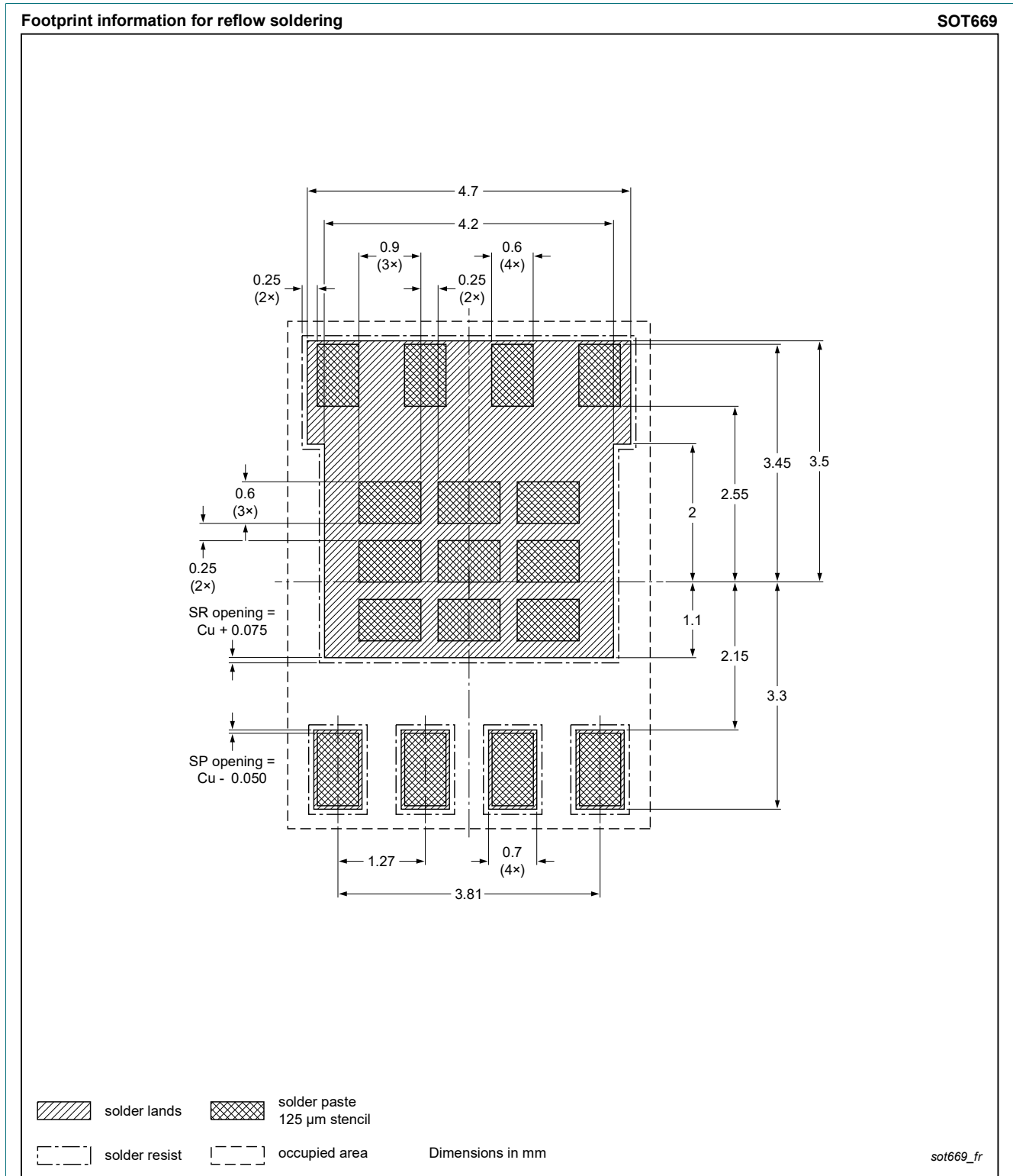
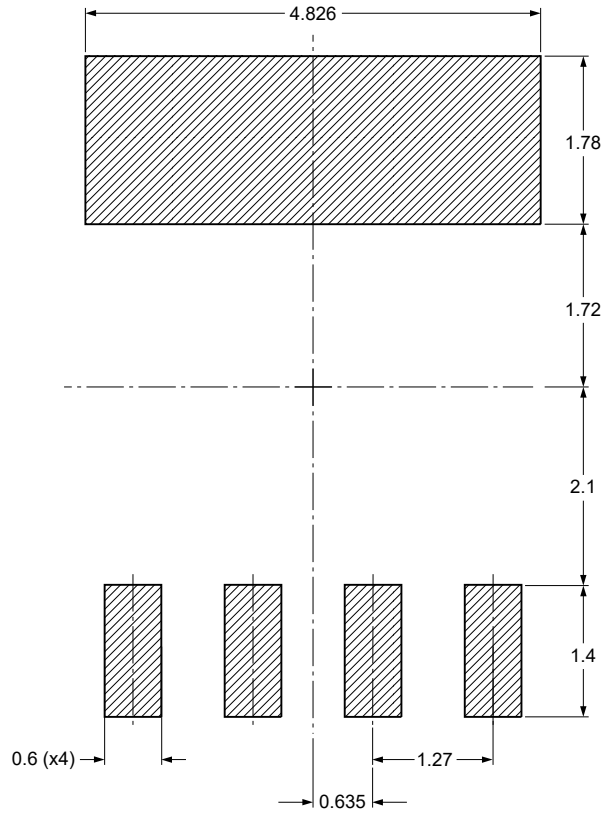


Fig. 15. Reflow soldering footprint for LFPK56; Power-SO8 (SOT669)

Wave soldering footprint information for LFPAK56 package

SOT669



 solder lands

Dimensions in mm

Issue date ~~15-04-13~~
15-04-16

sot669_fw

Fig. 16. Wave soldering footprint for LFPAK56; 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	-	-

15. Legal information

Data sheet status

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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- [2] The term 'short data sheet' is explained in section "Definitions".
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