



# PHPT61006NY

100 V, 6 A NPN high power bipolar transistor

26 January 2015

Product data sheet

## 1. General description

NPN high power bipolar transistor in a SOT669 (LFPAK56) Surface-Mounted Device (SMD) power plastic package.

PNP complement: PHPT61006PY

## 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
- AEC-Q101 qualified.

## 3. Applications

- Power management
- Load switch
- Linear mode voltage regulator
- Backlighting applications
- Motor drive
- Relay replacement

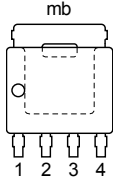
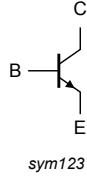
## 4. Quick reference data

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		-	-	6	A
$I_{CM}$	peak collector current	single pulse; $t_p \leq 1$ ms	-	-	12	A
$R_{CEsat}$	collector-emitter saturation resistance	$I_C = 6$ A; $I_B = 600$ mA; $t_p \leq 300$ $\mu$ s; $\delta \leq 0.02$ ; $T_{amb} = 25$ °C; pulsed	-	35	57	m $\Omega$

## 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	E	emitter	 <p><b>LFPAK56; Power-SO8 (SOT669)</b></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
PHPT61006NY	LFPAK56; Power-SO8	Plastic single-ended surface-mounted package (LFPAK56; Power-SO8); 4 leads	SOT669

## 7. Marking

Table 4. Marking codes

Type number	Marking code
PHPT61006NY	1006NAB

## 8. Limiting values

**Table 5. Limiting values**

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

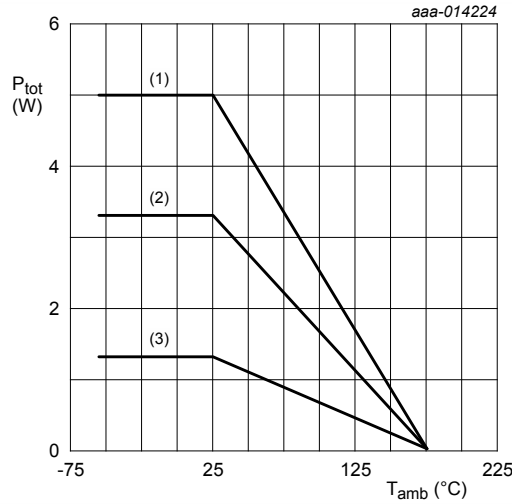
Symbol	Parameter	Conditions		Min	Max	Unit
$V_{CBO}$	collector-base voltage	open emitter		-	100	V
$V_{CEO}$	collector-emitter voltage	open base		-	100	V
$V_{EBO}$	emitter-base voltage	open collector		-	7	V
$I_C$	collector current			-	6	A
$I_{CM}$	peak collector current	single pulse; $t_p \leq 1$ ms		-	12	A
$I_B$	base current			-	1	A
$I_{BM}$	peak base current	single pulse; $t_p \leq 1$ ms		-	2	A
$P_{tot}$	total power dissipation	$T_{amb} \leq 25$ °C	[1]	-	1.3	W
			[2]	-	3.3	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 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.

[4] Power dissipation from junction to mounting base.



- (1) Ceramic PCB, Al<sub>2</sub>O<sub>3</sub>, standard footprint
- (2) FR4 PCB, mounting pad for collector 6 cm<sup>2</sup>
- (3) FR4 PCB, standard footprint

Fig. 1. Power derating curves

## 9. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
R <sub>th(j-a)</sub>	thermal resistance from junction to ambient	in free air	[1]	-	-	115	K/W
			[2]	-	-	45	K/W
			[3]	-	-	30	K/W
R <sub>th(j-mb)</sub>	thermal resistance from junction to mounting base			-	-	6	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 mounting pad for collector 6 cm<sup>2</sup>.

[3] Device mounted on an ceramic Printed-Circuit Board (PCB), Al<sub>2</sub>O<sub>3</sub>, standard footprint.

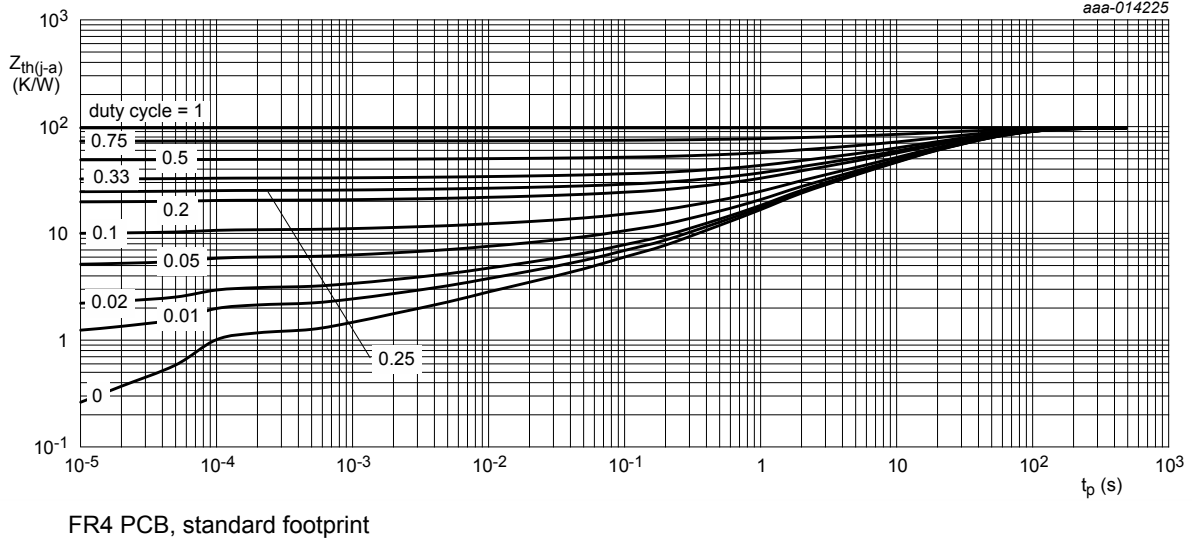


Fig. 2. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

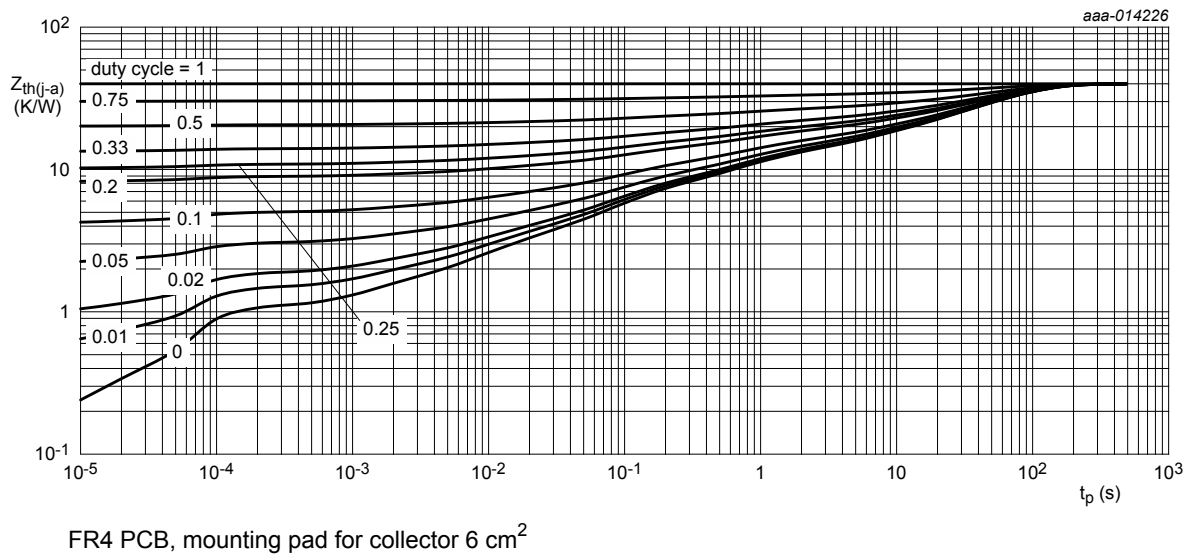


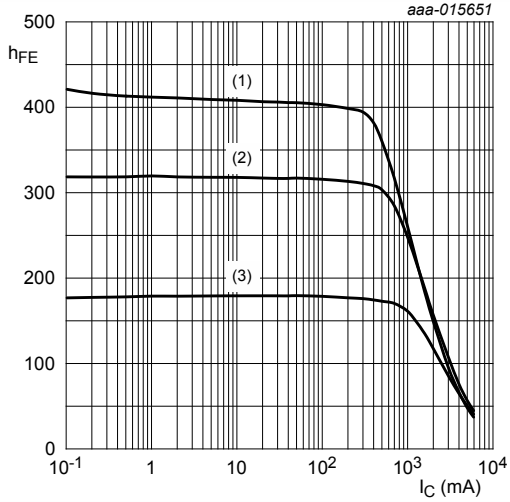
Fig. 3. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

## 10. Characteristics

Table 7. Characteristics

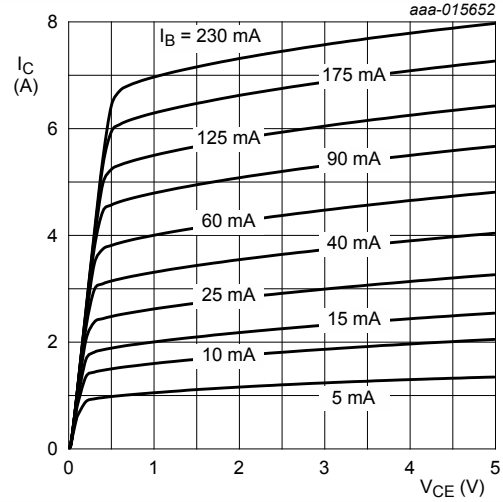
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I <sub>CBO</sub>	collector-base cut-off current	V <sub>CB</sub> = 80 V; I <sub>E</sub> = 0 A; T <sub>amb</sub> = 25 °C	-	-	100	nA
		V <sub>CB</sub> = 80 V; I <sub>E</sub> = 0 A; T <sub>j</sub> = 150 °C	-	-	50	μA
I <sub>CES</sub>	collector-emitter cut-off current	V <sub>CE</sub> = 80 V; V <sub>BE</sub> = 0 V; T <sub>amb</sub> = 25 °C	-	-	100	nA
I <sub>EBO</sub>	emitter-base cut-off current	V <sub>EB</sub> = 7 V; I <sub>C</sub> = 0 A; T <sub>amb</sub> = 25 °C	-	-	100	nA
h <sub>FE</sub>	DC current gain	V <sub>CE</sub> = 2 V; I <sub>C</sub> = 500 mA; T <sub>amb</sub> = 25 °C	140	260	-	

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
		$V_{CE} = 2 \text{ V}; I_C = 1 \text{ A}; t_p \leq 300 \mu\text{s};$ $\delta \leq 0.02; T_{amb} = 25 \text{ }^\circ\text{C}$	120	210	-	
		$V_{CE} = 2 \text{ V}; I_C = 3 \text{ A}; t_p \leq 300 \mu\text{s};$ $\delta \leq 0.02; T_{amb} = 25 \text{ }^\circ\text{C}$	50	90	-	
		$V_{CE} = 2 \text{ V}; I_C = 6 \text{ A}; t_p \leq 300 \mu\text{s};$ $\delta \leq 0.02; T_{amb} = 25 \text{ }^\circ\text{C}; \text{pulsed}$	25	40	-	
$V_{CEsat}$	collector-emitter saturation voltage	$I_C = 1 \text{ A}; I_B = 50 \text{ mA}; t_p \leq 300 \mu\text{s};$ $\delta \leq 0.02; T_{amb} = 25 \text{ }^\circ\text{C}; \text{pulsed}$	-	45	65	mV
		$I_C = 3 \text{ A}; I_B = 300 \text{ mA}; \text{pulsed};$ $t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^\circ\text{C}$	-	100	150	mV
		$I_C = 6 \text{ A}; I_B = 600 \text{ mA}; \text{pulsed};$ $t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^\circ\text{C}$	-	210	340	mV
$R_{CEsat}$	collector-emitter saturation resistance	$I_C = 6 \text{ A}; I_B = 600 \text{ mA}; t_p \leq 300 \mu\text{s};$ $\delta \leq 0.02; T_{amb} = 25 \text{ }^\circ\text{C}; \text{pulsed}$	-	35	57	m $\Omega$
$V_{BEsat}$	base-emitter saturation voltage	$I_C = 1 \text{ A}; I_B = 50 \text{ mA}; \text{pulsed};$ $t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^\circ\text{C}$	-	0.85	1	V
		$I_C = 3 \text{ A}; I_B = 300 \text{ mA}; \text{pulsed};$ $t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^\circ\text{C}$	-	1.05	1.3	V
		$I_C = 6 \text{ A}; I_B = 600 \text{ mA}; \text{pulsed};$ $t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^\circ\text{C}$	-	1.1	1.3	V
$V_{BEon}$	base-emitter turn-on voltage	$V_{CE} = 2 \text{ V}; I_C = 500 \text{ mA}; T_{amb} = 25 \text{ }^\circ\text{C}$	-	0.7	0.9	V
$t_d$	delay time	$V_{CC} = 12.5 \text{ V}; I_C = 3 \text{ A}; I_{Bon} = 150 \text{ mA};$ $I_{Boff} = -150 \text{ mA}; T_{amb} = 25 \text{ }^\circ\text{C}$	-	10	-	ns
$t_r$	rise time		-	365	-	ns
$t_{on}$	turn-on time		-	375	-	ns
$t_s$	storage time		-	285	-	ns
$t_f$	fall time		-	385	-	ns
$t_{off}$	turn-off time		-	670	-	ns
$f_T$	transition frequency		$V_{CE} = 10 \text{ V}; I_C = 500 \text{ mA}; f = 100 \text{ MHz};$ $T_{amb} = 25 \text{ }^\circ\text{C}$	-	170	-
$C_c$	collector capacitance	$V_{CB} = 10 \text{ V}; I_E = 0 \text{ A}; i_e = 0 \text{ A};$ $f = 1 \text{ MHz}; T_{amb} = 25 \text{ }^\circ\text{C}$	-	22	-	pF



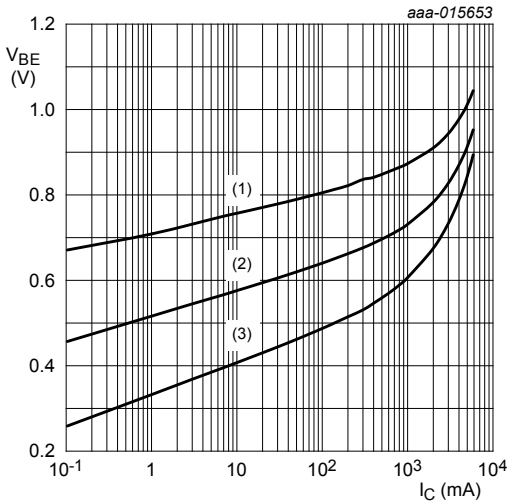
$V_{CE} = 2\text{ V}$   
 (1)  $T_{amb} = 100\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = -55\text{ °C}$

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



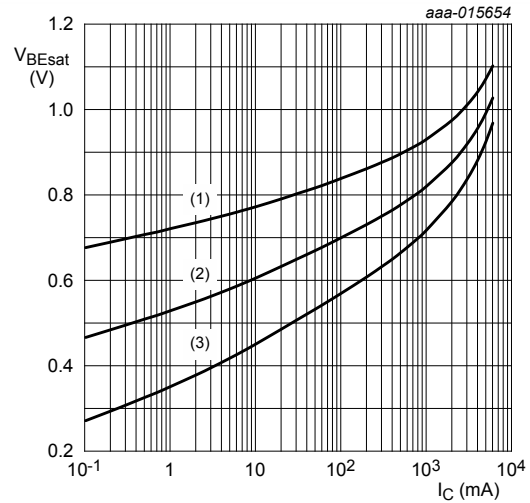
$T_{amb} = 25\text{ °C}$

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



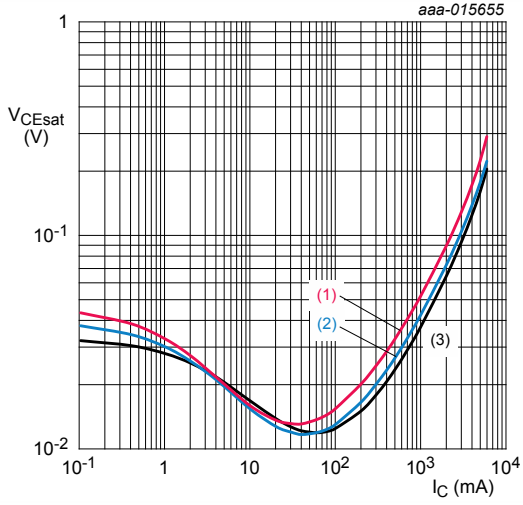
$V_{CE} = 2\text{ V}$   
 (1)  $T_{amb} = -55\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = 100\text{ °C}$

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



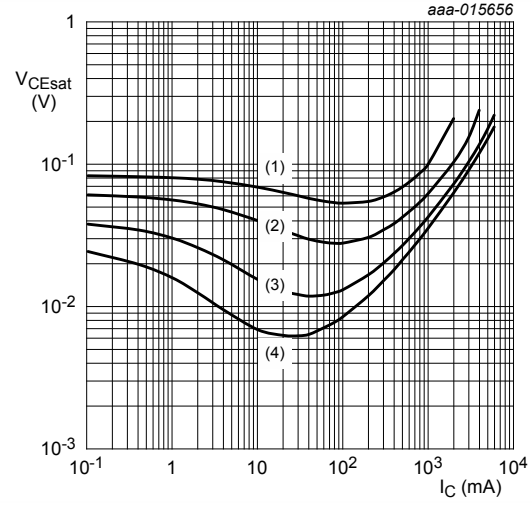
$I_C/I_B = 20$   
 (1)  $T_{amb} = -55\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = 100\text{ °C}$

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



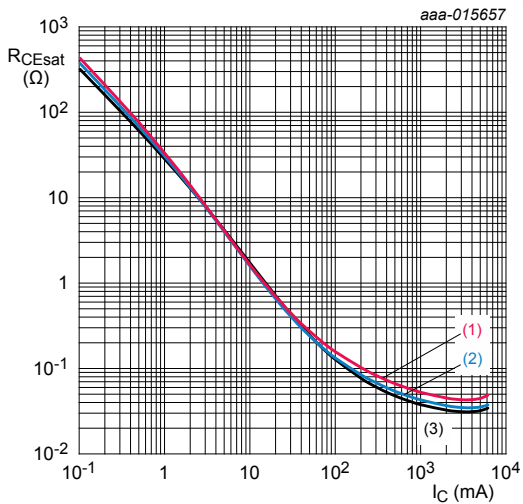
$I_C/I_B = 20$   
 (1)  $T_{amb} = 100\text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25\text{ }^\circ\text{C}$   
 (3)  $T_{amb} = -55\text{ }^\circ\text{C}$

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



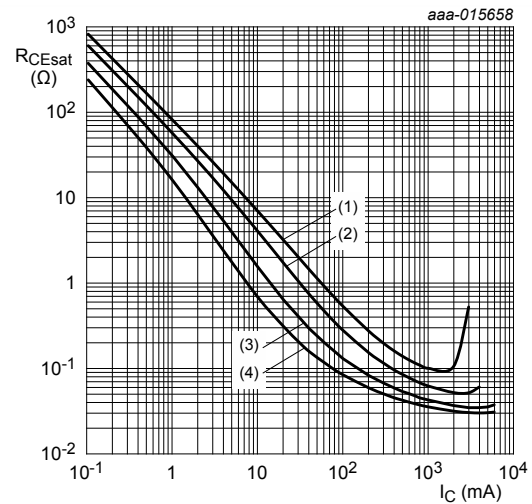
$T_{amb} = 25\text{ }^\circ\text{C}$   
 (1)  $I_C/I_B = 100$   
 (2)  $I_C/I_B = 50$   
 (3)  $I_C/I_B = 20$   
 (4)  $I_C/I_B = 10$

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)  $I_C/I_B = 100$   
 (2)  $I_C/I_B = 50$   
 (3)  $I_C/I_B = 20$   
 (4)  $I_C/I_B = 10$

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



### 11. Test information

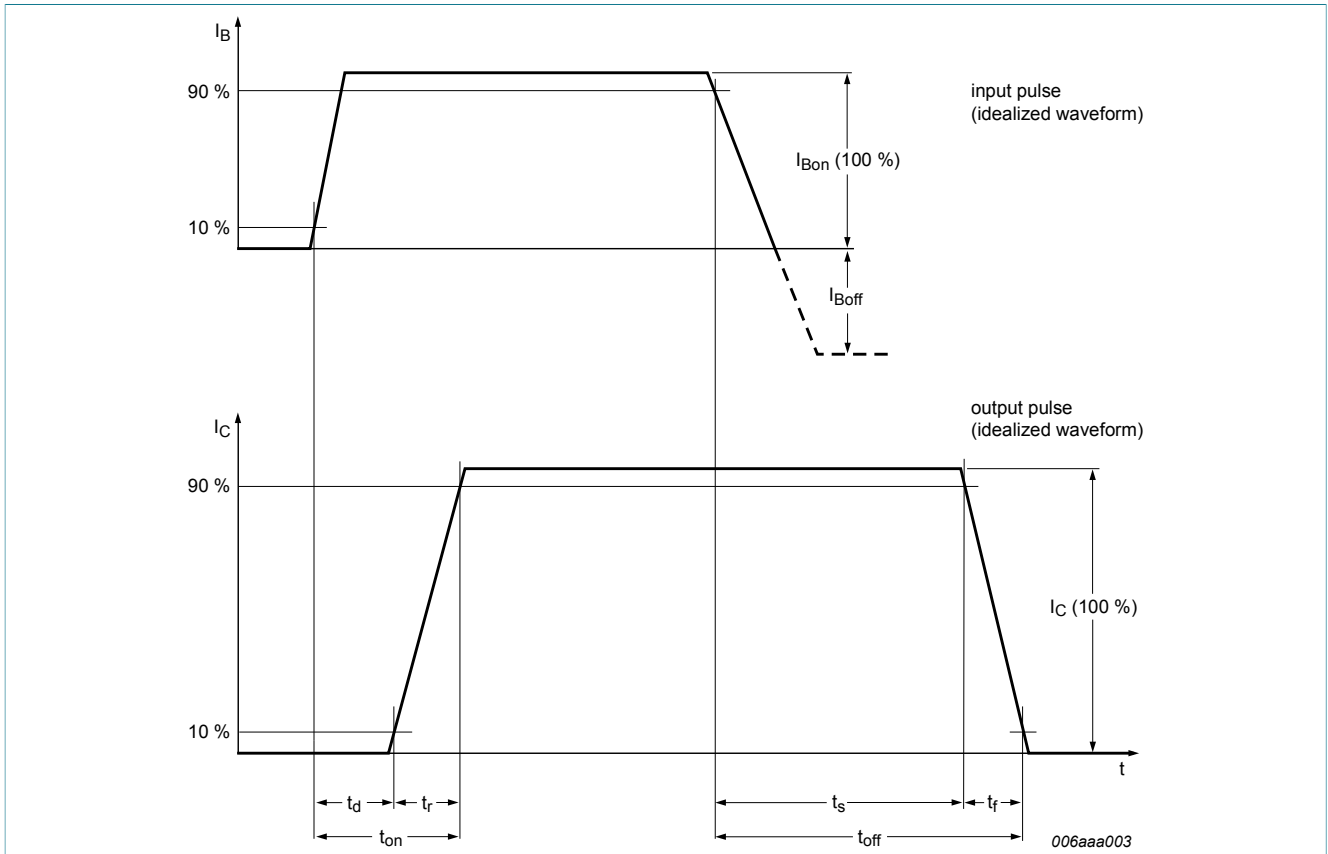


Fig. 12. BISS transistor switching time definition

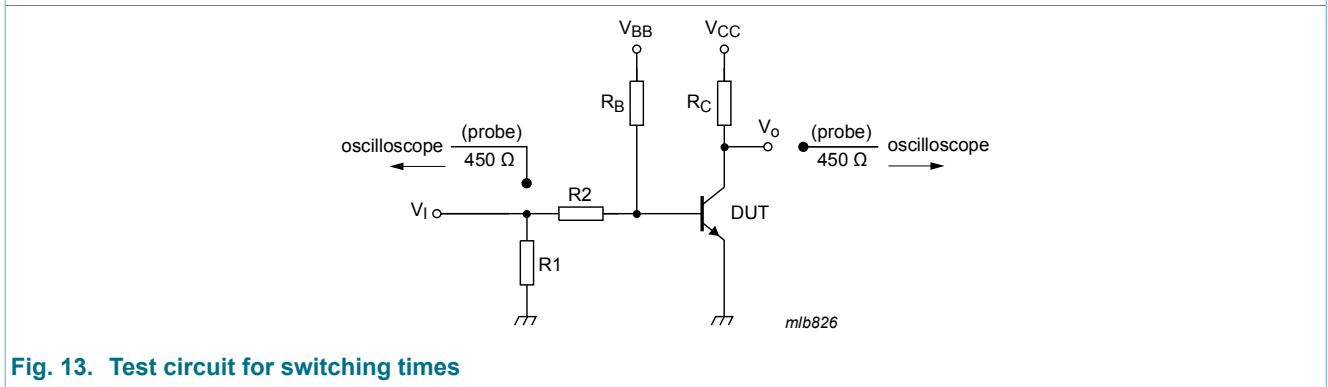


Fig. 13. Test circuit for switching times

#### 11.1 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.

## 12. Package outline

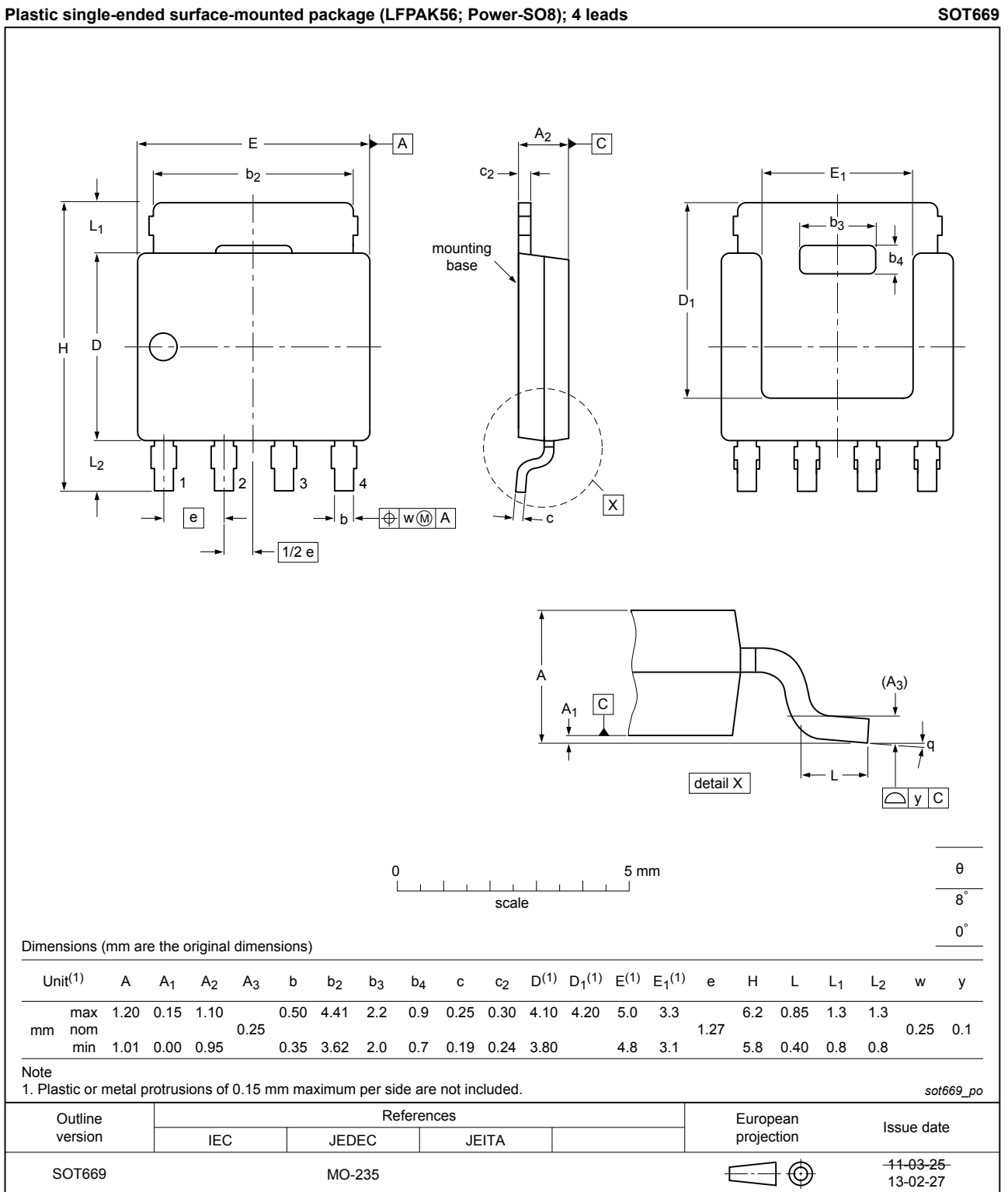


Fig. 14. Package outline LFAK56; Power-SO8 (SOT669)

### 13. Soldering

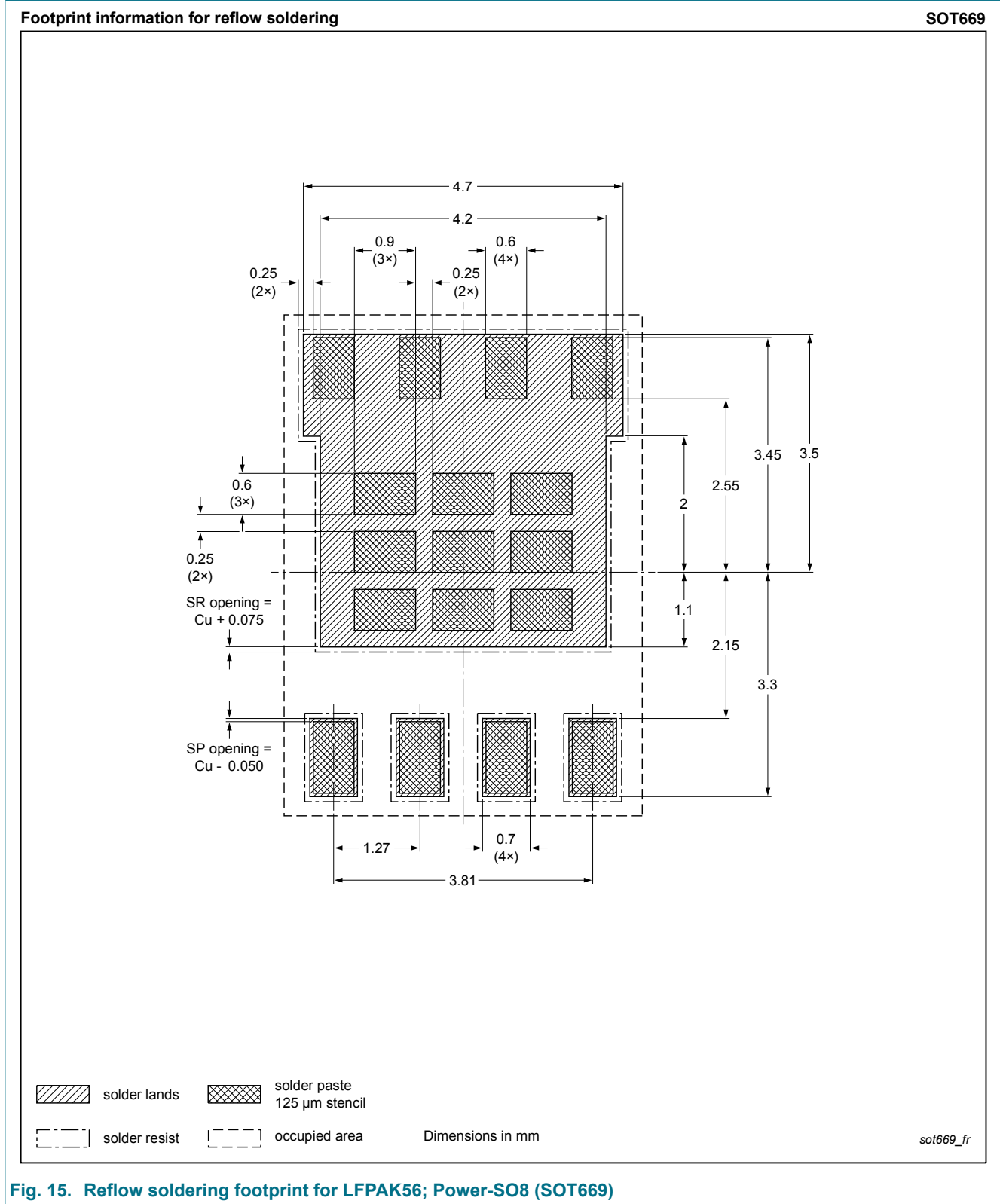


Fig. 15. Reflow soldering footprint for LFPAK56; Power-SO8 (SOT669)

## 14. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PHPT61006NY v.1	20150126	Product data sheet	-	-

## 15. Legal information

### 15.1 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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## 16. 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 .....	9
11.1	Quality information .....	9
12	Package outline .....	10
13	Soldering .....	11
14	Revision history .....	12
15	Legal information .....	13
15.1	Data sheet status .....	13
15.2	Definitions .....	13
15.3	Disclaimers .....	13
15.4	Trademarks .....	14

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