



# PHPT610035PK

PNP/PNP matched high power double bipolar transistor

24 October 2014

Product data sheet

## 1. General description

PNP/PNP high power matched double bipolar transistor in a SOT1205 (LFPAK56D) Surface-Mounted Device (SMD) power plastic package. Matched version of PHPT610030PK.

NPN/NPN complement: PHPT610035NK.

## 2. Features and benefits

- Current gain matching 10 %
- High thermal power dissipation capability
- Suitable for 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

- Current mirror
- Motor control
- Power management
- Backlighting applications
- Relay replacement
- Differential amplifiers

## 4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
<b>Per transistor</b>							
$V_{CEO}$	collector-emitter voltage	open base		-	-	-100	V
$I_C$	collector current			-	-	-3	A
<b>Per transistor</b>							
$R_{CEsat}$	collector-emitter saturation resistance	$I_C = -2 \text{ A}$ ; $I_B = -200 \text{ mA}$ ; pulsed; $t_p \leq 300 \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{amb} = 25 \text{ }^\circ\text{C}$		-	110	180	$\text{m}\Omega$



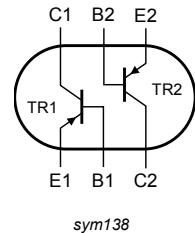
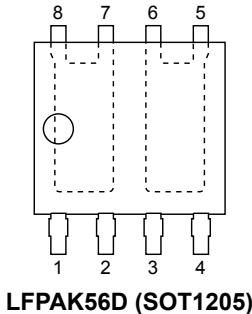
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## 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	E1	emitter TR1		
2	B1	base TR1		
3	E2	emitter TR2		
4	B2	base TR2		
5	C2	collector TR2		
6	C2	collector TR2		
7	C1	collector TR1		
8	C1	collector TR1		



## 6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PHPT610035PK	LFPAK56D	Plastic single ended surface mounted package (LFPAK56D); 8 leads	SOT1205

## 7. Limiting values

**Table 4. Limiting values**

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

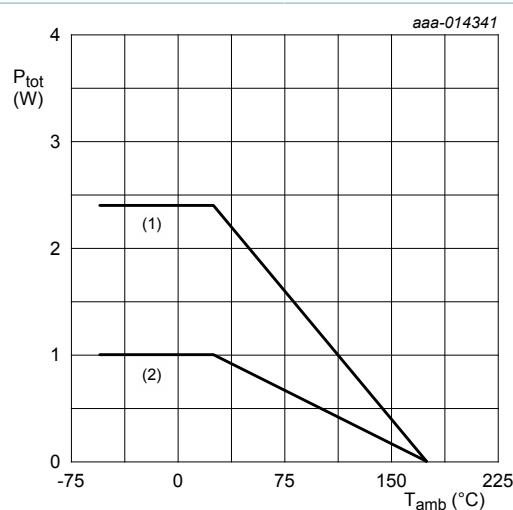
Symbol	Parameter	Conditions		Min	Max	Unit
<b>Per transistor</b>						
$V_{CBO}$	collector-base voltage	open emitter		-	-100	V
$V_{CEO}$	collector-emitter voltage	open base		-	-100	V
$V_{EBO}$	emitter-base voltage	open collector		-	-8	V
$I_C$	collector current			-	-3	A
$I_{CM}$	peak collector current	single pulse; $t_p \leq 1$ ms		-	-8	A
$I_B$	base current			-	-0.5	A
$P_{tot}$	total power dissipation	$T_{amb} \leq 25$ °C	[1]	-	1	W
			[2]	-	2.4	W
			[3]	-	25	W
<b>Per device</b>						
$P_{tot}$	total power dissipation	$T_{amb} \leq 25$ °C	[1]	-	1.25	W
			[2]	-	3	W
			[4]	-	5	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 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] Power dissipation from junction to mounting base.

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



(1) FR4 PCB, mounting pad for collector 6 cm<sup>2</sup>

(2) FR4 PCB, standard footprint

Fig. 1. Per transistor: power derating curves

## 8. Thermal characteristics

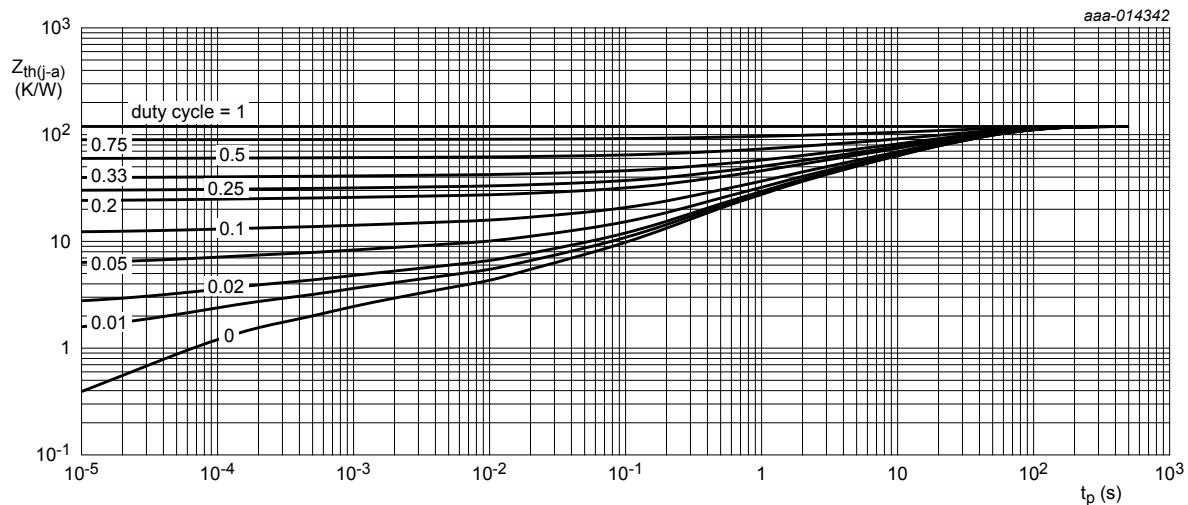
Table 5. Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Per transistor</b>						
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	-	150 K/W
			[2]	-	-	62.5 K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point			-	-	6 K/W
<b>Per device</b>						
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	-	120 K/W
			[2]	-	-	50 K/W
			[3]	-	-	30 K/W

[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.

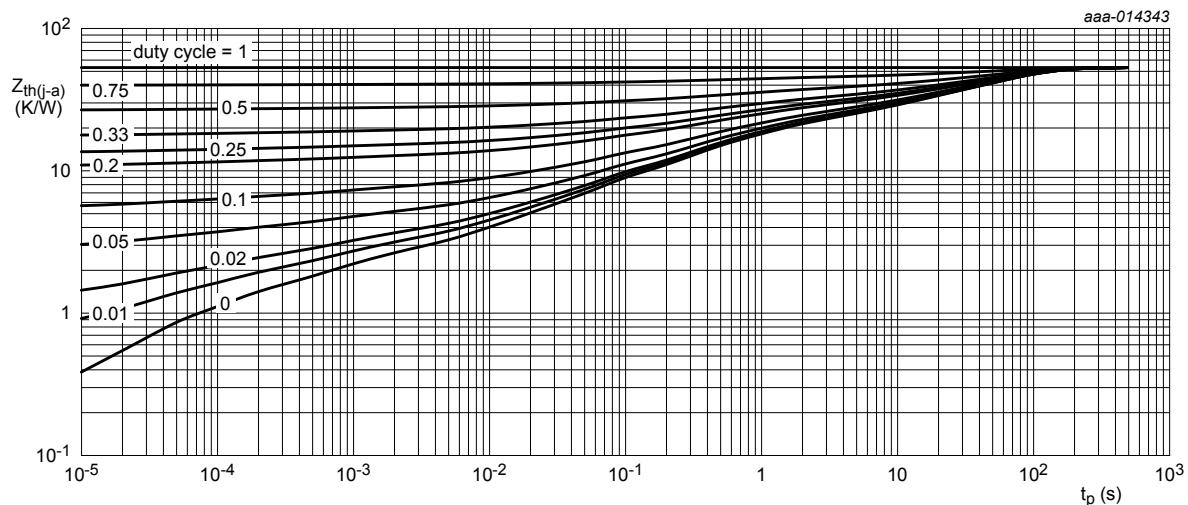
[2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 6 cm<sup>2</sup>.

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



FR4 PCB, standard footprint

**Fig. 2. Per transistor: transient thermal impedance from junction to ambient as a function of pulse duration; typical values**



FR4 PCB, mounting pad for collector  $6 \text{ cm}^2$

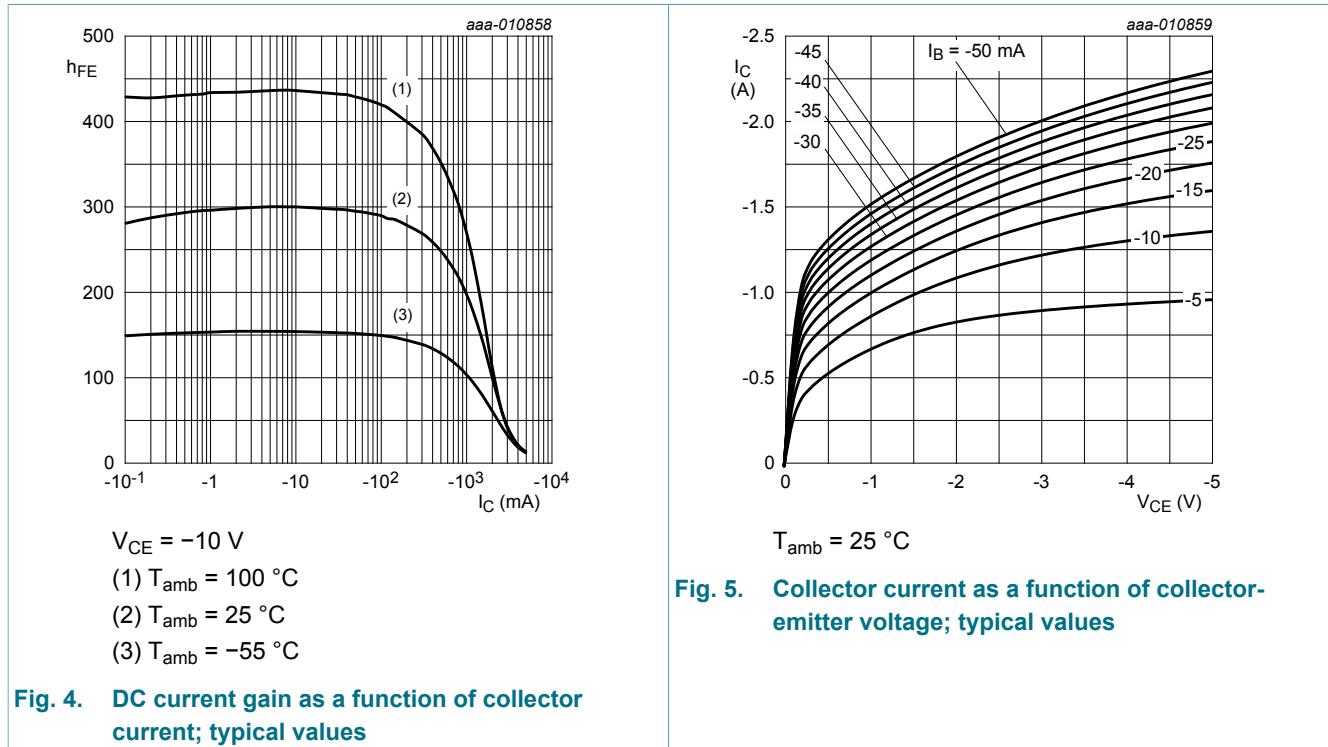
**Fig. 3. Per transistor: transient thermal impedance from junction to ambient as a function of pulse duration; typical values**

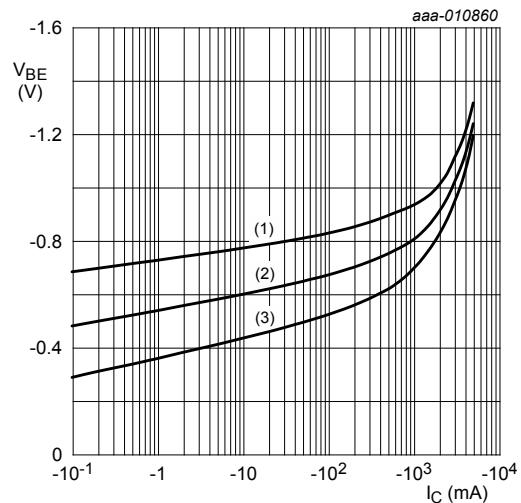
## 9. Characteristics

**Table 6. Characteristics**

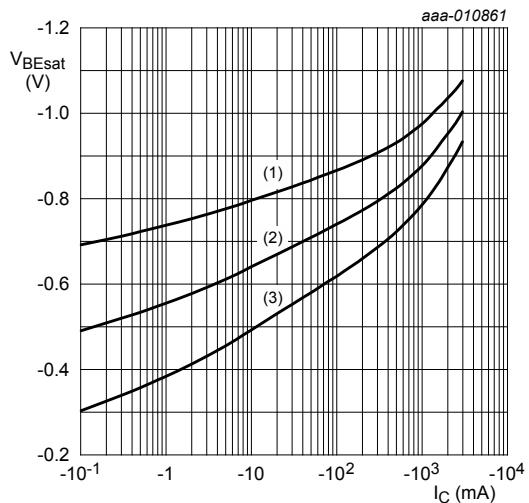
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$h_{FE1}/h_{FE2}$	$h_{FE}$ matching	$V_{CE} = -2 \text{ V}$ ; $I_C = 1 \text{ A}$		0.9	1	1.1	
<b>Per transistor</b>							
$I_{CBO}$	collector-base cut-off current	$V_{CB} = -80 \text{ V}$ ; $I_E = 0 \text{ A}$ ; $T_{amb} = 25 \text{ }^\circ\text{C}$		-	-	-100	nA
		$V_{CB} = -80 \text{ V}$ ; $I_E = 0 \text{ A}$ ; $T_j = 150 \text{ }^\circ\text{C}$		-	-	-50	$\mu\text{A}$
$I_{CES}$	collector-emitter cut-off current	$V_{CE} = -80 \text{ V}$ ; $V_{BE} = 0 \text{ V}$ ; $T_{amb} = 25 \text{ }^\circ\text{C}$		-	-	-100	nA
$I_{EBO}$	emitter-base cut-off current	$V_{EB} = -7 \text{ V}$ ; $I_C = 0 \text{ A}$ ; $T_{amb} = 25 \text{ }^\circ\text{C}$		-	-	-100	nA
$h_{FE}$	DC current gain	$V_{CE} = -10 \text{ V}$ ; $I_C = -500 \text{ mA}$ ; $T_{amb} = 25 \text{ }^\circ\text{C}$		150	220	-	
		$V_{CE} = -10 \text{ V}$ ; $I_C = -1 \text{ A}$ ; pulsed; $t_p \leq 300 \text{ } \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{amb} = 25 \text{ }^\circ\text{C}$		80	210	-	
		$V_{CE} = -10 \text{ V}$ ; $I_C = -2 \text{ A}$ ; pulsed; $t_p \leq 300 \text{ } \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{amb} = 25 \text{ }^\circ\text{C}$		20	100	-	
		$V_{CE} = -2 \text{ V}$ ; $I_C = -1 \text{ A}$ ; $T_{amb} = 25 \text{ }^\circ\text{C}$		100	200	-	
		$V_{CE} = -10 \text{ V}$ ; $I_C = -3 \text{ A}$ ; pulsed; $t_p \leq 300 \text{ } \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{amb} = 25 \text{ }^\circ\text{C}$		10	40	-	
$V_{CEsat}$	collector-emitter saturation voltage	$I_C = -500 \text{ mA}$ ; $I_B = -50 \text{ mA}$ ; $T_{amb} = 25 \text{ }^\circ\text{C}$		-	-70	-110	mV
		$I_C = -2 \text{ A}$ ; $I_B = -200 \text{ mA}$ ; pulsed; $t_p \leq 300 \text{ } \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{amb} = 25 \text{ }^\circ\text{C}$		-	-220	-360	mV
$R_{CEsat}$	collector-emitter saturation resistance			-	110	180	$\text{m}\Omega$
$V_{BEsat}$	base-emitter saturation voltage	$I_C = -1 \text{ A}$ ; $I_B = -50 \text{ mA}$ ; pulsed; $t_p \leq 300 \text{ } \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{amb} = 25 \text{ }^\circ\text{C}$		-	-0.91	-1	V
		$I_C = -2 \text{ A}$ ; $I_B = -200 \text{ mA}$ ; pulsed; $t_p \leq 300 \text{ } \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{amb} = 25 \text{ }^\circ\text{C}$		-	-1.02	-1.2	V
$V_{BEon}$	base-emitter turn-on voltage	$V_{CE} = -2 \text{ V}$ ; $I_C = -100 \text{ mA}$ ; pulsed; $t_p \leq 300 \text{ } \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{amb} = 25 \text{ }^\circ\text{C}$		-	-0.68	-0.9	V
$t_d$	delay time	$V_{CC} = -12.5 \text{ V}$ ; $I_C = -1 \text{ A}$ ; $I_{Bon} = -50 \text{ mA}$ ; $I_{Boff} = 50 \text{ mA}$ ; $T_{amb} = 25 \text{ }^\circ\text{C}$		-	20	-	ns
$t_r$	rise time			-	180	-	ns
$t_{on}$	turn-on time			-	200	-	ns
$t_s$	storage time			-	350	-	ns
$t_f$	fall time			-	220	-	ns
$t_{off}$	turn-off time			-	570	-	ns

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$f_T$	transition frequency	$V_{CE} = -10 \text{ V}$ ; $I_C = -100 \text{ mA}$ ; $f = 100 \text{ MHz}$ ; $T_{amb} = 25 \text{ }^\circ\text{C}$		-	125	-	MHz
$C_c$	collector capacitance	$V_{CB} = -10 \text{ V}$ ; $I_E = 0 \text{ A}$ ; $i_e = 0 \text{ A}$ ; $f = 1 \text{ MHz}$ ; $T_{amb} = 25 \text{ }^\circ\text{C}$		-	30	-	pF

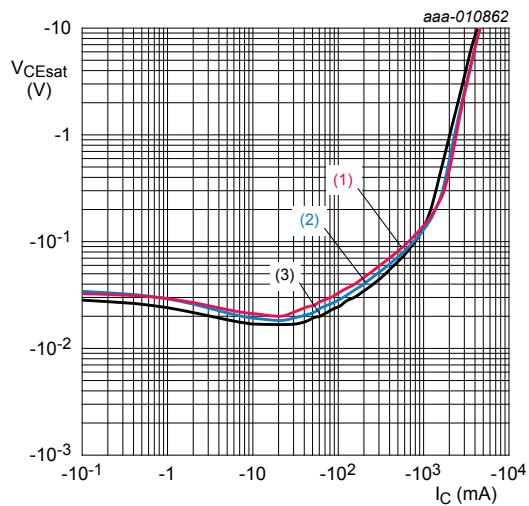




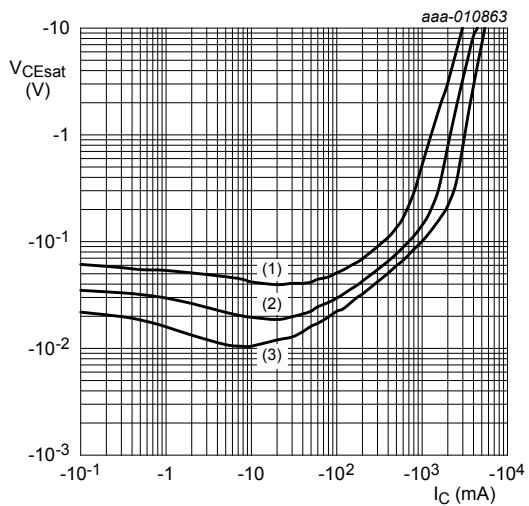
**Fig. 6. Base-emitter voltage as a function of collector current; typical values**



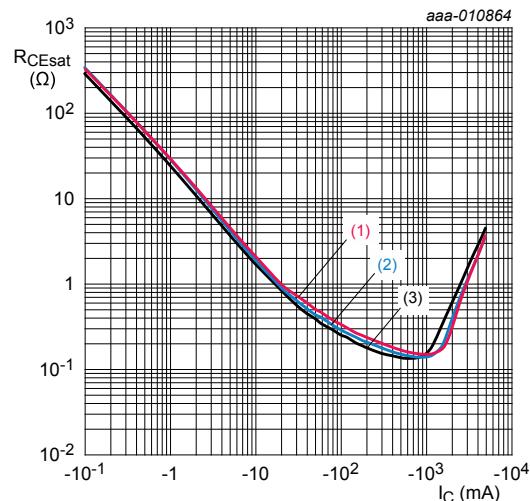
**Fig. 7. Base-emitter saturation voltage as a function of collector current; typical values**



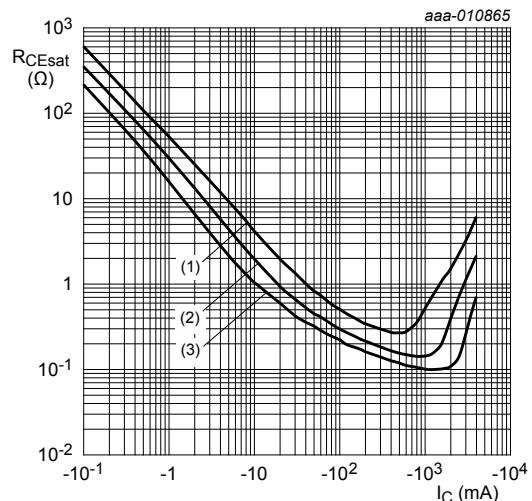
**Fig. 8. Collector-emitter saturation voltage as a function of collector current; typical values**



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



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



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

## 10. Test information

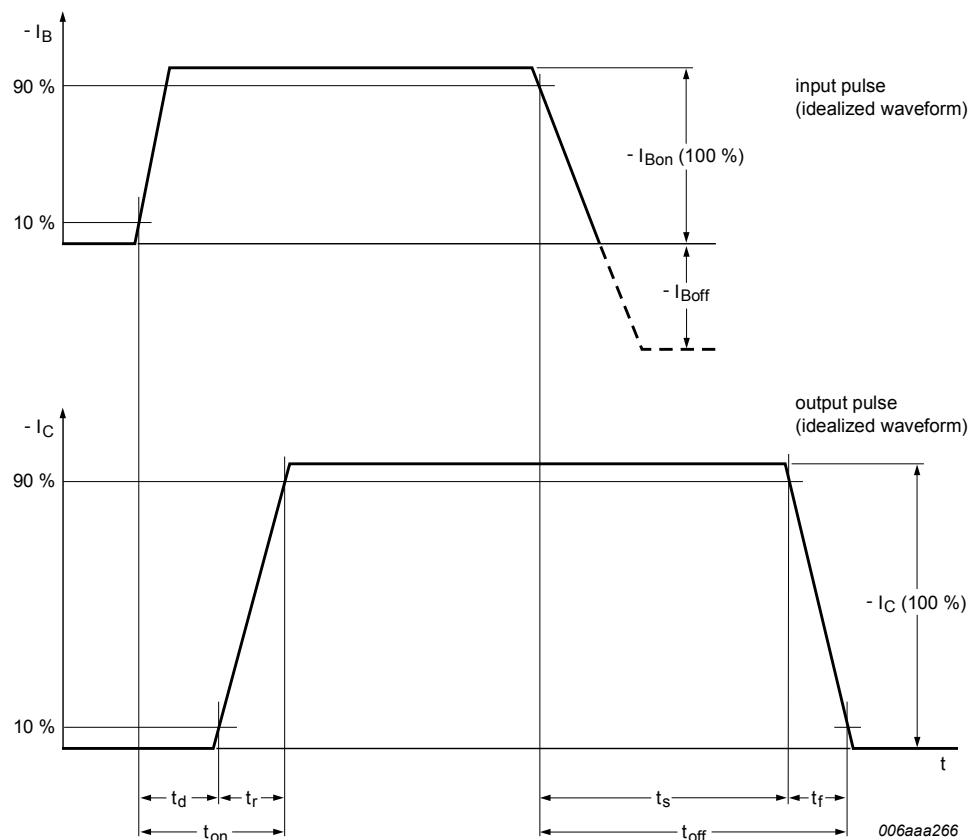


Fig. 12. BISS transistor switching time definition

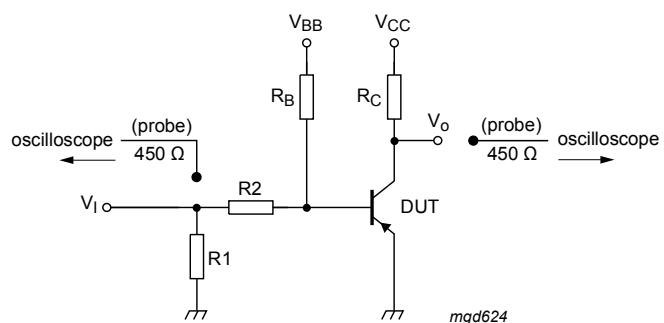


Fig. 13. Test circuit for switching times

## 10.1 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.

## 11. Package outline

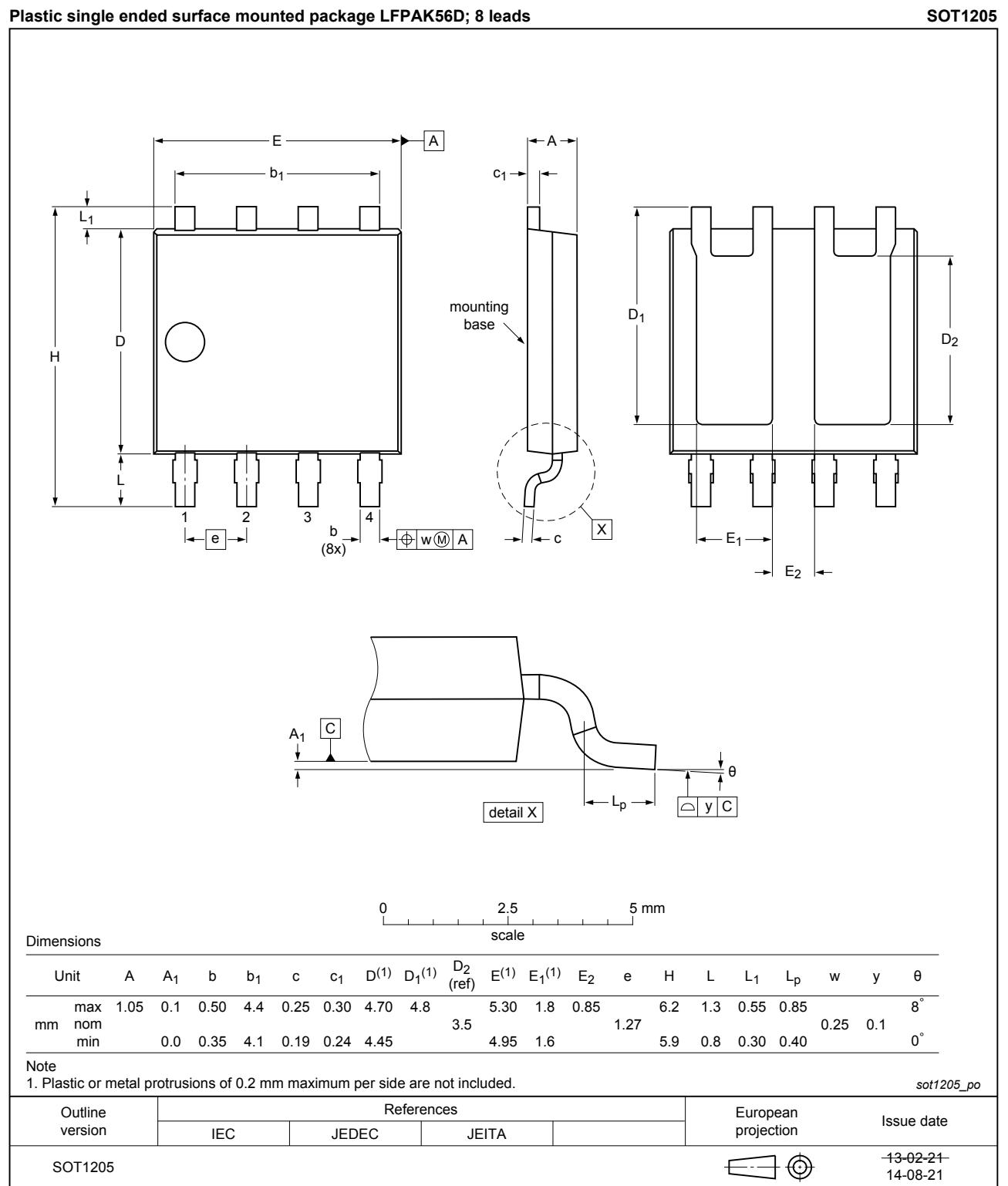


Fig. 14. Package outline LFPAK56D (SOT1205)

## 12. Soldering

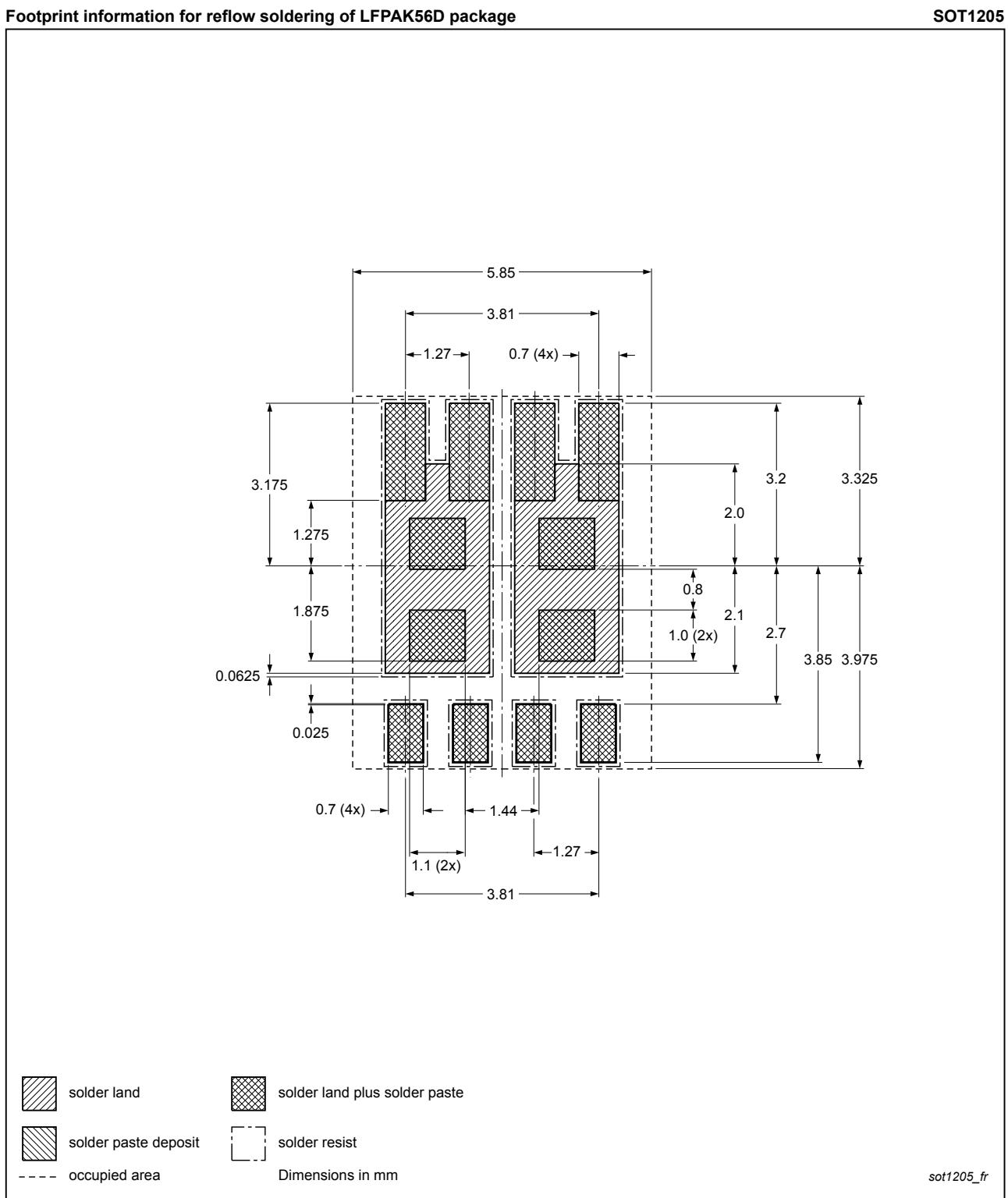


Fig. 15. Reflow soldering footprint for LFPAK56D (SOT1205)

## 13. Revision history

**Table 7. Revision history**

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PHPT610035PK v.1	20141024	Product data sheet	-	-

## 14. Legal information

### 14.1 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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## 15. 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	Limiting values .....	3
8	Thermal characteristics .....	4
9	Characteristics .....	6
10	Test information .....	10
10.1	Quality information .....	10
11	Package outline .....	11
12	Soldering .....	12
13	Revision history .....	13
14	Legal information .....	14
14.1	Data sheet status .....	14
14.2	Definitions .....	14
14.3	Disclaimers .....	14
14.4	Trademarks .....	15

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Date of release: 24 October 2014

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