



# PHPT610030PK

PNP/PNP high power double bipolar transistor

22 October 2014

Product data sheet

## 1. General description

PNP/PNP high power double bipolar transistor in a SOT1205 (LFAK56D) Surface-Mounted Device (SMD) power plastic package.

NPN/NPN complement: PHPT610030NK.

NPN/PNP complement: PHPT610030NPK.

## 2. Features and benefits

- 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

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

## 4. Quick reference data

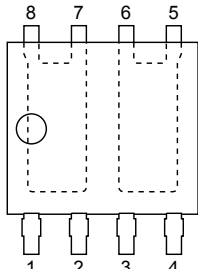
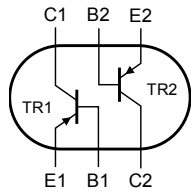
Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Per transistor</b>						
$V_{CE0}$	collector-emitter voltage	open base	-	-	-100	V
$I_C$	collector current		-	-	-3	A
<b>Per transistor</b>						
$R_{CEsat}$	collector-emitter saturation resistance	$I_C = -2$ A; $I_B = -0.2$ A; pulsed; $t_p \leq 300$ $\mu$ s; $\delta \leq 0.02$ ; $T_{amb} = 25$ °C	-	110	180	m $\Omega$



## 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	E1	emitter TR1	 <p>LFPAK56D (SOT1205)</p>	 <p>sym138</p>
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		Version
	Name	Description	
PHPT610030PK	LFPAK56D	Plastic single ended surface mounted package (LFPAK56D); 8 leads	SOT1205

## 7. Marking

Table 4. Marking codes

Type number	Marking code
PHPT610030PK	10030PK

## 8. Limiting values

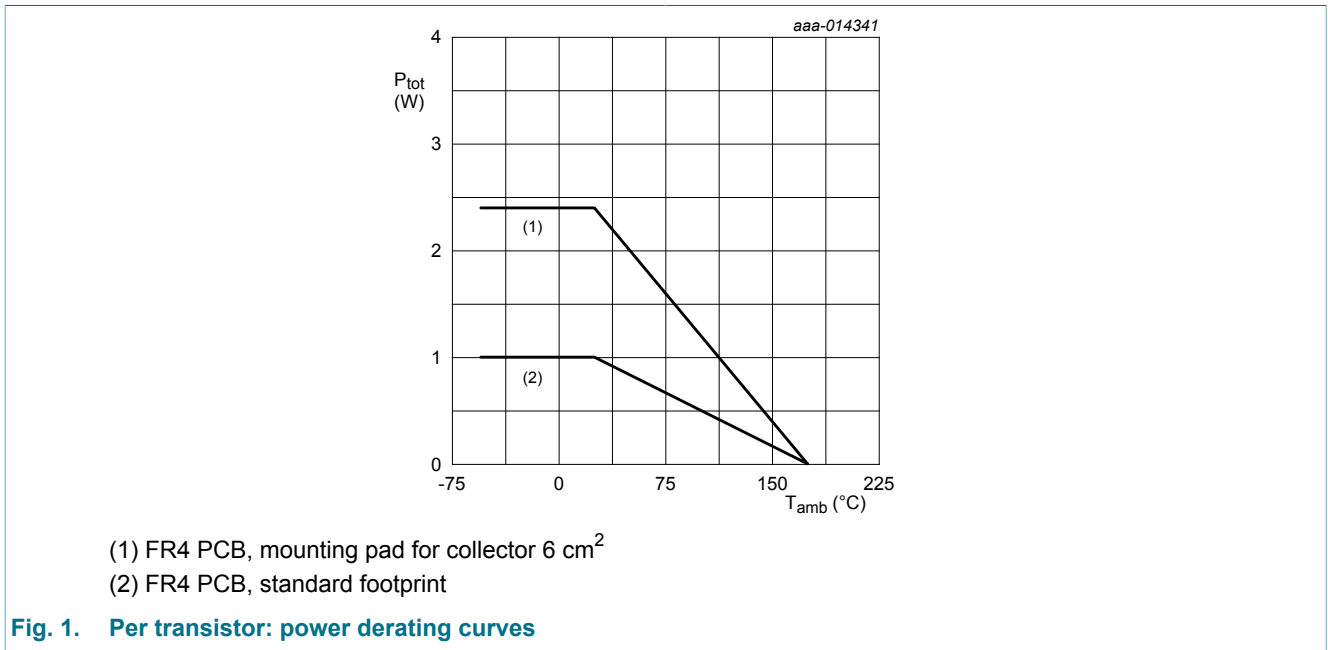
Table 5. Limiting values

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

Symbol	Parameter	Conditions		Min	Max	Unit
P <sub>tot</sub>	total power dissipation	T <sub>amb</sub> ≤ 25 °C	[1]	-	1	W
			[2]	-	2.4	W
			[3]	-	25	W
<b>Per device</b>						
P <sub>tot</sub>	total power dissipation	T <sub>amb</sub> ≤ 25 °C	[1]	-	1.25	W
			[2]	-	3	W
			[4]	-	5	W
T <sub>j</sub>	junction temperature			-	175	°C
T <sub>amb</sub>	ambient temperature			-55	175	°C
T <sub>stg</sub>	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.

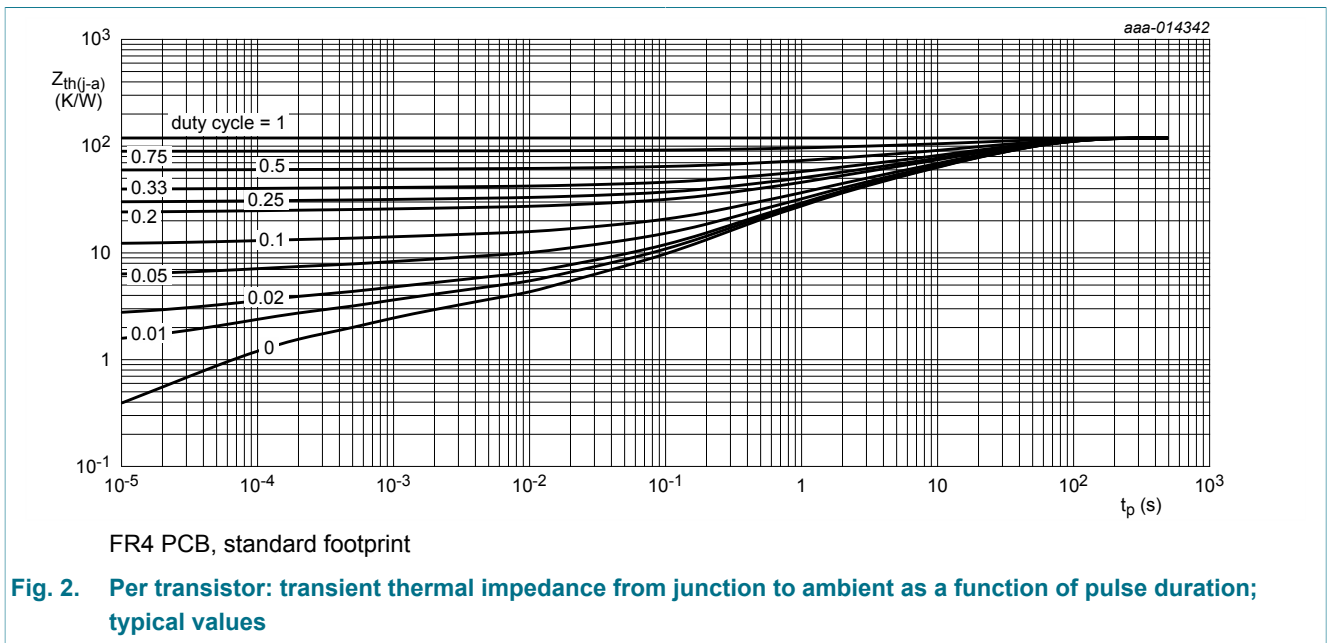


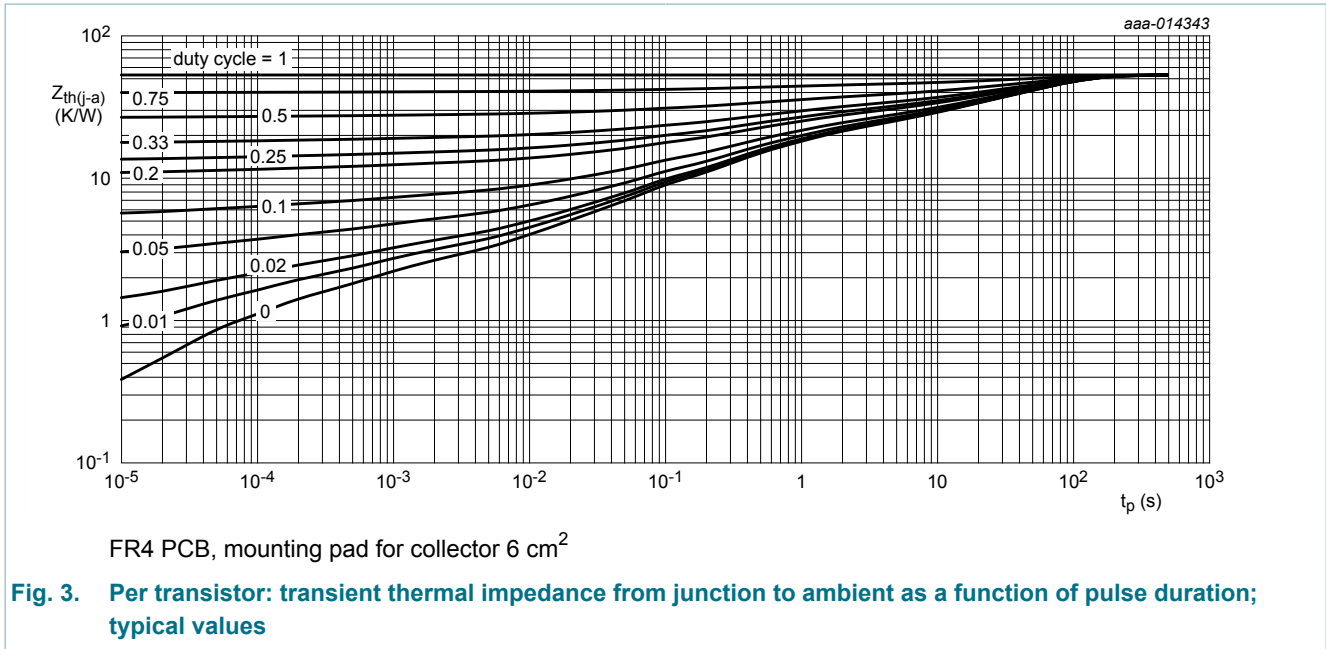
### 9. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
<b>Per transistor</b>							
R <sub>th(j-a)</sub>	thermal resistance from junction to ambient	in free air	[1]	-	-	150	K/W
			[2]	-	-	62.5	K/W
R <sub>th(j-sp)</sub>	thermal resistance from junction to solder point			-	-	6	K/W
<b>Per device</b>							
R <sub>th(j-a)</sub>	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.



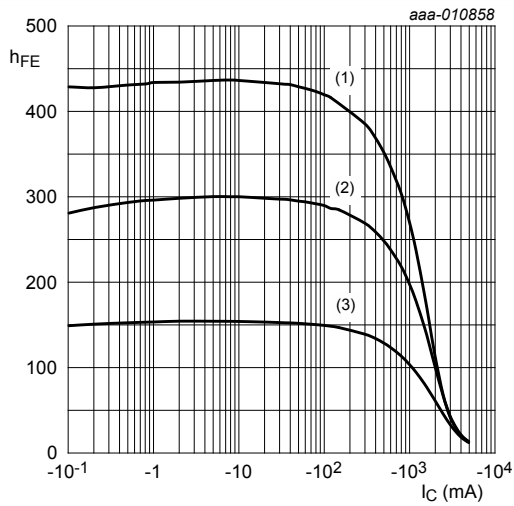


## 10. Characteristics

Table 7. Characteristics

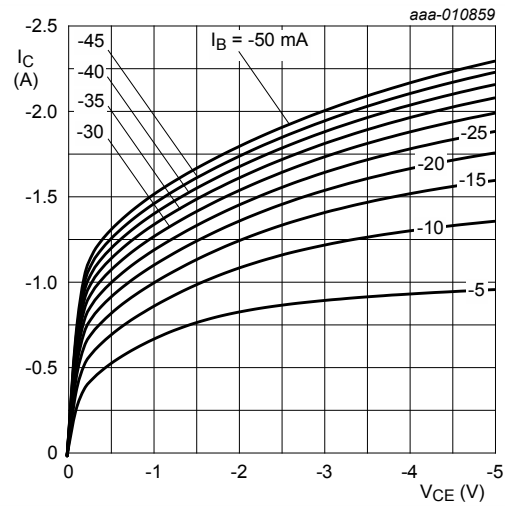
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Per transistor</b>						
I <sub>CBO</sub>	collector-base cut-off current	V <sub>CB</sub> = -80 V; I <sub>E</sub> = 0 A; T <sub>amb</sub> = 25 °C	-	-	-100	nA
		V <sub>CB</sub> = -80 V; I <sub>E</sub> = 0 A; T <sub>j</sub> = 150 °C	-	-	-50	μA
I <sub>CES</sub>	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> = -10 V; I <sub>C</sub> = -500 mA; T <sub>amb</sub> = 25 °C	150	220	-	
		V <sub>CE</sub> = -10 V; I <sub>C</sub> = -1 A; pulsed; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C	80	210	-	
		V <sub>CE</sub> = -10 V; I <sub>C</sub> = -2 A; pulsed; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C	20	100	-	
		V <sub>CE</sub> = -10 V; I <sub>C</sub> = -3 A; pulsed; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C	10	40	-	
V <sub>CEsat</sub>	collector-emitter saturation voltage	I <sub>C</sub> = -500 mA; I <sub>B</sub> = -50 mA; T <sub>amb</sub> = 25 °C	-	-70	-110	mV
		I <sub>C</sub> = -2 A; I <sub>B</sub> = -200 mA; pulsed; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C	-	-220	-360	mV

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{CEsat}$	collector-emitter saturation resistance	$I_C = -2\text{ A}$ ; $I_B = -0.2\text{ A}$ ; pulsed; $t_p \leq 300\ \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{amb} = 25\text{ }^\circ\text{C}$	-	110	180	m $\Omega$
$V_{BEsat}$	base-emitter saturation voltage	$I_C = -1\text{ A}$ ; $I_B = -50\text{ mA}$ ; pulsed; $t_p \leq 300\ \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{amb} = 25\text{ }^\circ\text{C}$	-	-0.91	-1	V
		$I_C = -2\text{ A}$ ; $I_B = -200\text{ mA}$ ; pulsed; $t_p \leq 300\ \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{amb} = 25\text{ }^\circ\text{C}$	-	-1.02	-1.2	V
$V_{BEon}$	base-emitter turn-on voltage	$V_{CE} = -2\text{ V}$ ; $I_C = -100\text{ mA}$ ; pulsed; $t_p \leq 300\ \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{amb} = 25\text{ }^\circ\text{C}$	-	-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
$f_T$	transition frequency		$V_{CE} = -10\text{ V}$ ; $I_C = -100\text{ mA}$ ; $f = 100\text{ MHz}$ ; $T_{amb} = 25\text{ }^\circ\text{C}$	-	125	-
$C_c$	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



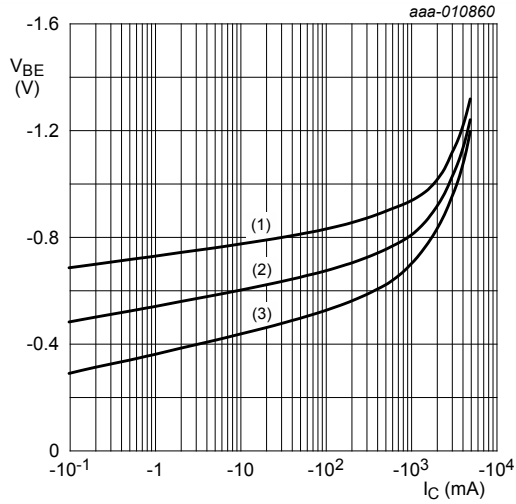
$V_{CE} = -10\text{ V}$   
 (1)  $T_{amb} = 100\text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25\text{ }^\circ\text{C}$   
 (3)  $T_{amb} = -55\text{ }^\circ\text{C}$

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



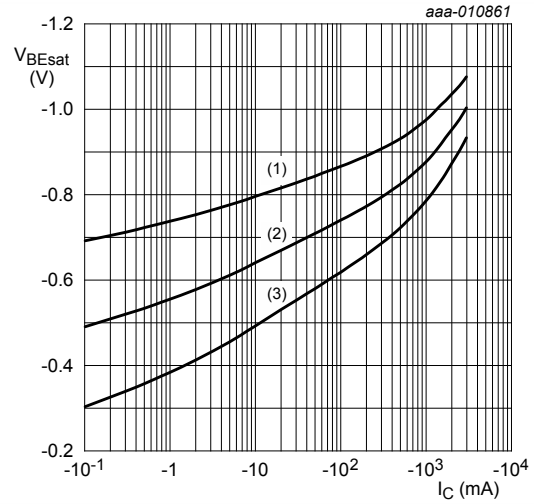
$T_{amb} = 25\text{ }^\circ\text{C}$

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



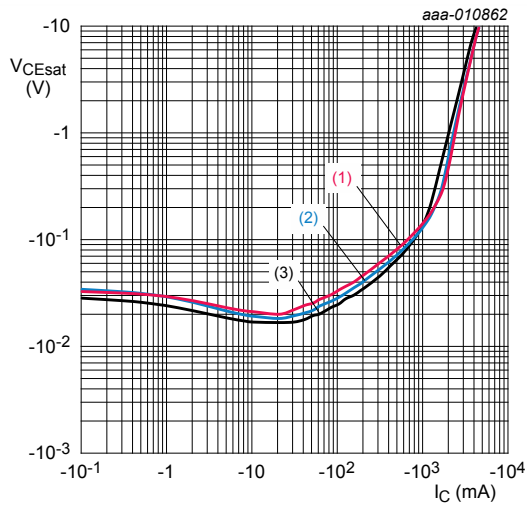
$V_{CE} = -2 \text{ V}$   
 (1)  $T_{amb} = -55 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = 100 \text{ }^\circ\text{C}$

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



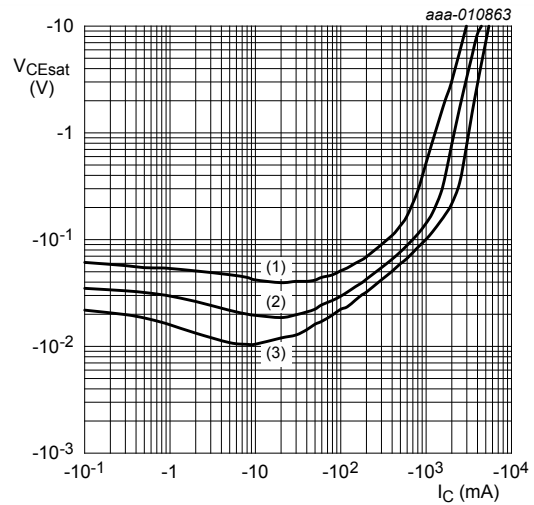
$I_C/I_B = 20$   
 (1)  $T_{amb} = -55 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = 100 \text{ }^\circ\text{C}$

**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**

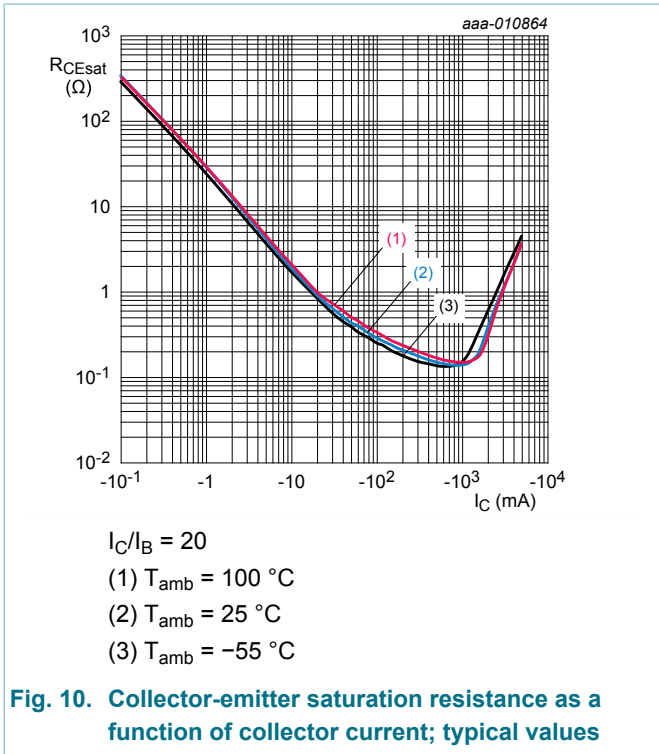


Fig. 10. Collector-emitter saturation resistance as a function of collector current; typical values

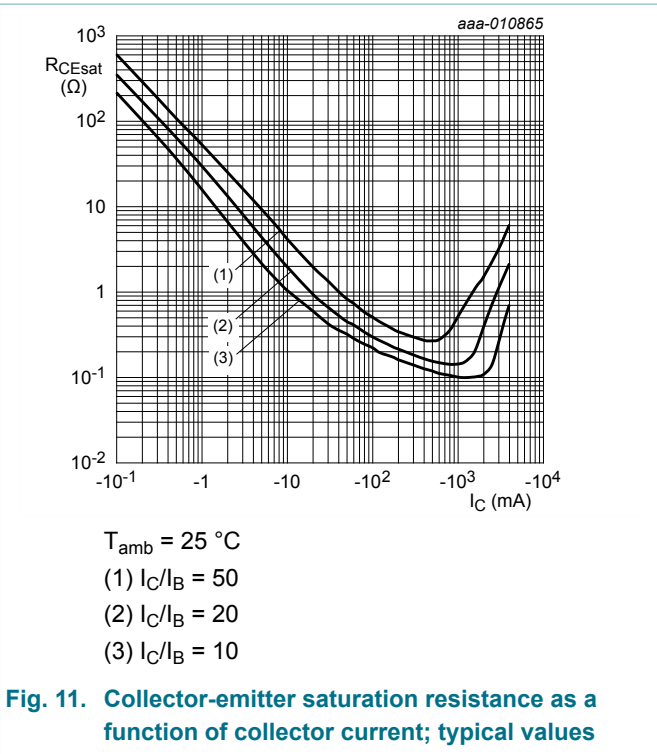


Fig. 11. Collector-emitter saturation resistance as a function of collector current; typical values



### 11. Test information

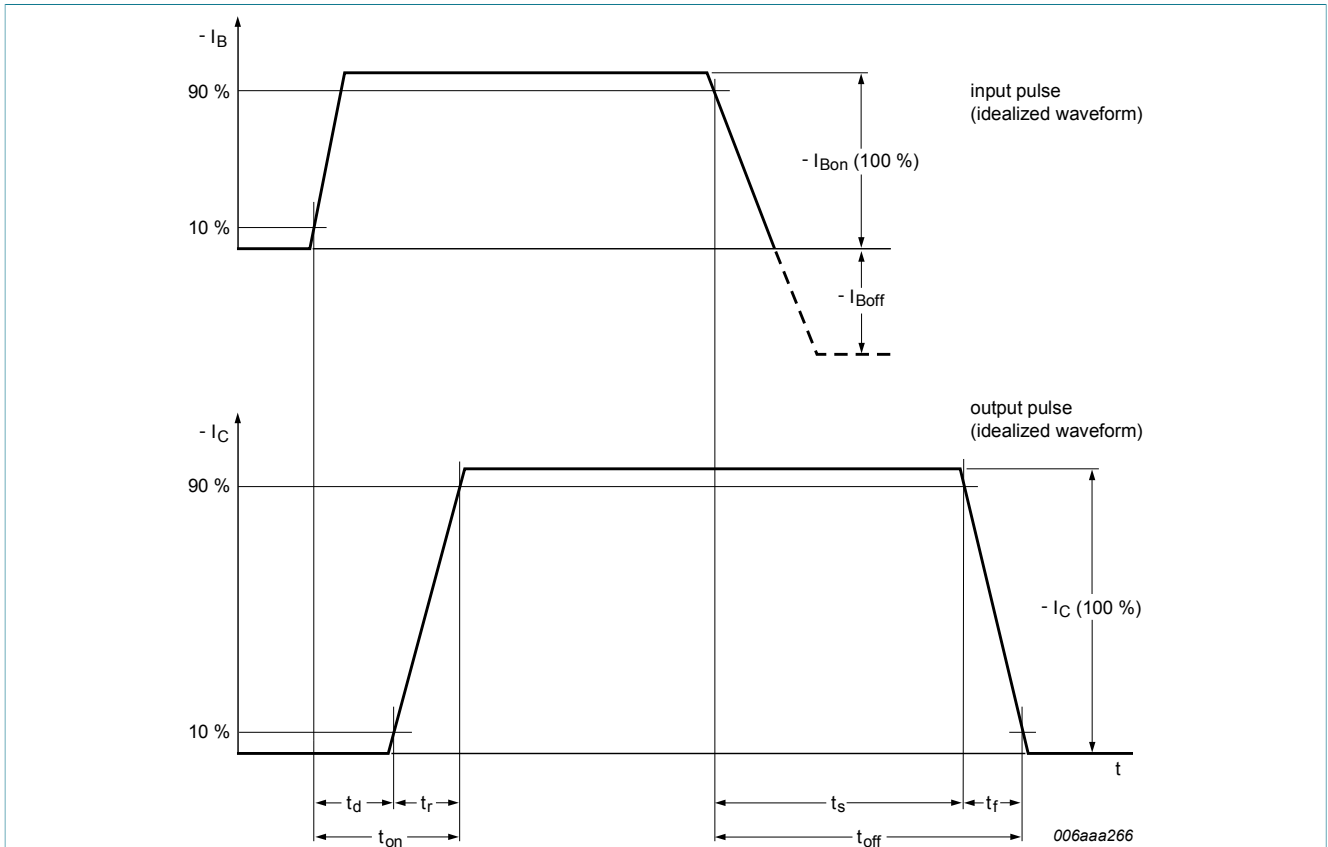


Fig. 12. BISS transistor switching time definition

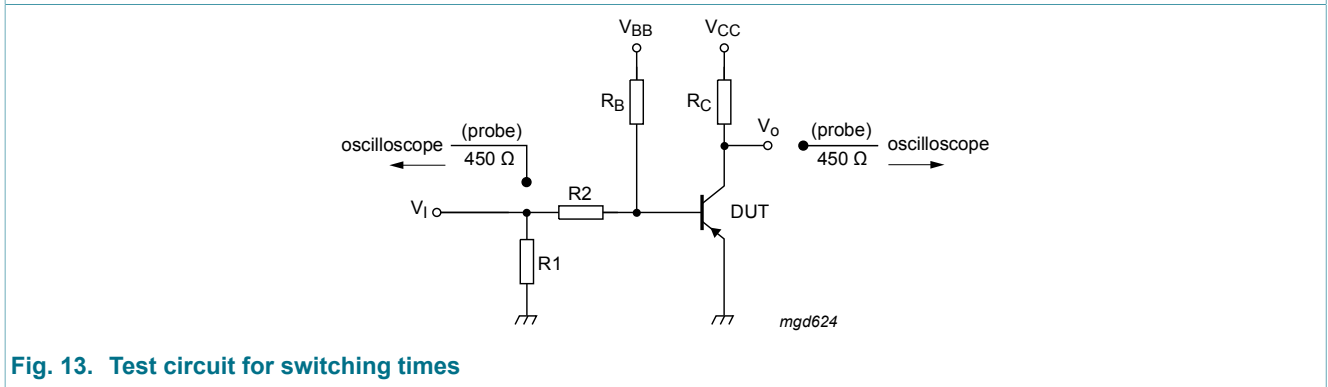


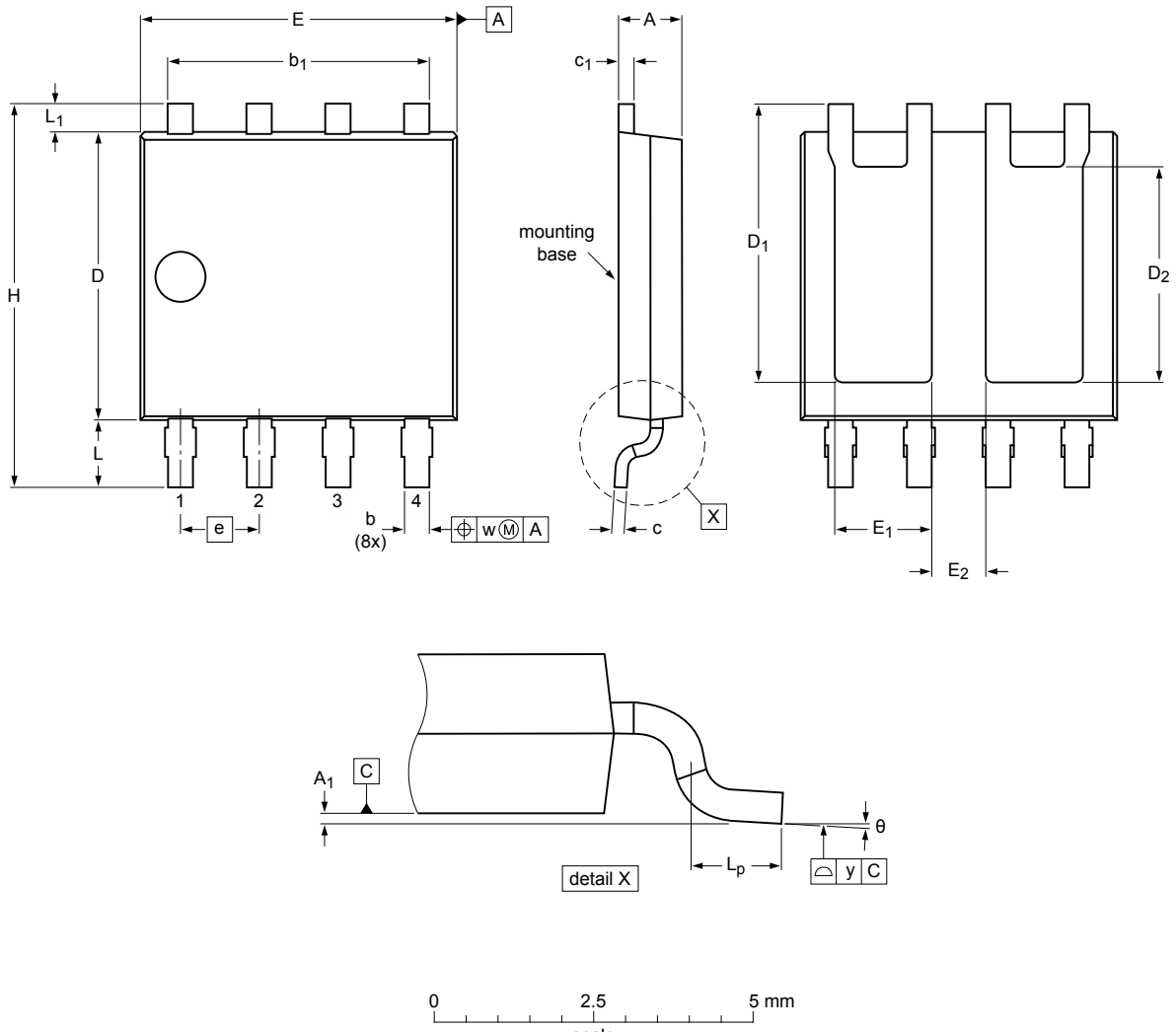
Fig. 13. Test circuit for switching times

#### 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

Plastic single ended surface mounted package LFAK56D; 8 leads SOT1205



Dimensions

Unit	A	A <sub>1</sub>	b	b <sub>1</sub>	c	c <sub>1</sub>	D <sup>(1)</sup>	D <sub>1</sub> <sup>(1)</sup>	D <sub>2</sub> <sup>(ref)</sup>	E <sup>(1)</sup>	E <sub>1</sub> <sup>(1)</sup>	E <sub>2</sub>	e	H	L	L <sub>1</sub>	L <sub>p</sub>	w	y	θ	
max	1.05	0.1	0.50	4.4	0.25	0.30	4.70	4.8	3.5	5.30	1.8	0.85	6.2	1.3	0.55	0.85		0.25	0.1	8°	
nom													1.27								
min		0.0	0.35	4.1	0.19	0.24	4.45			4.95	1.6		5.9	0.8	0.30	0.40				0°	

Note

1. Plastic or metal protrusions of 0.2 mm maximum per side are not included.

sot1205\_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT1205						13-02-21 14-08-21

Fig. 14. Package outline LFAK56D (SOT1205)

### 13. Soldering

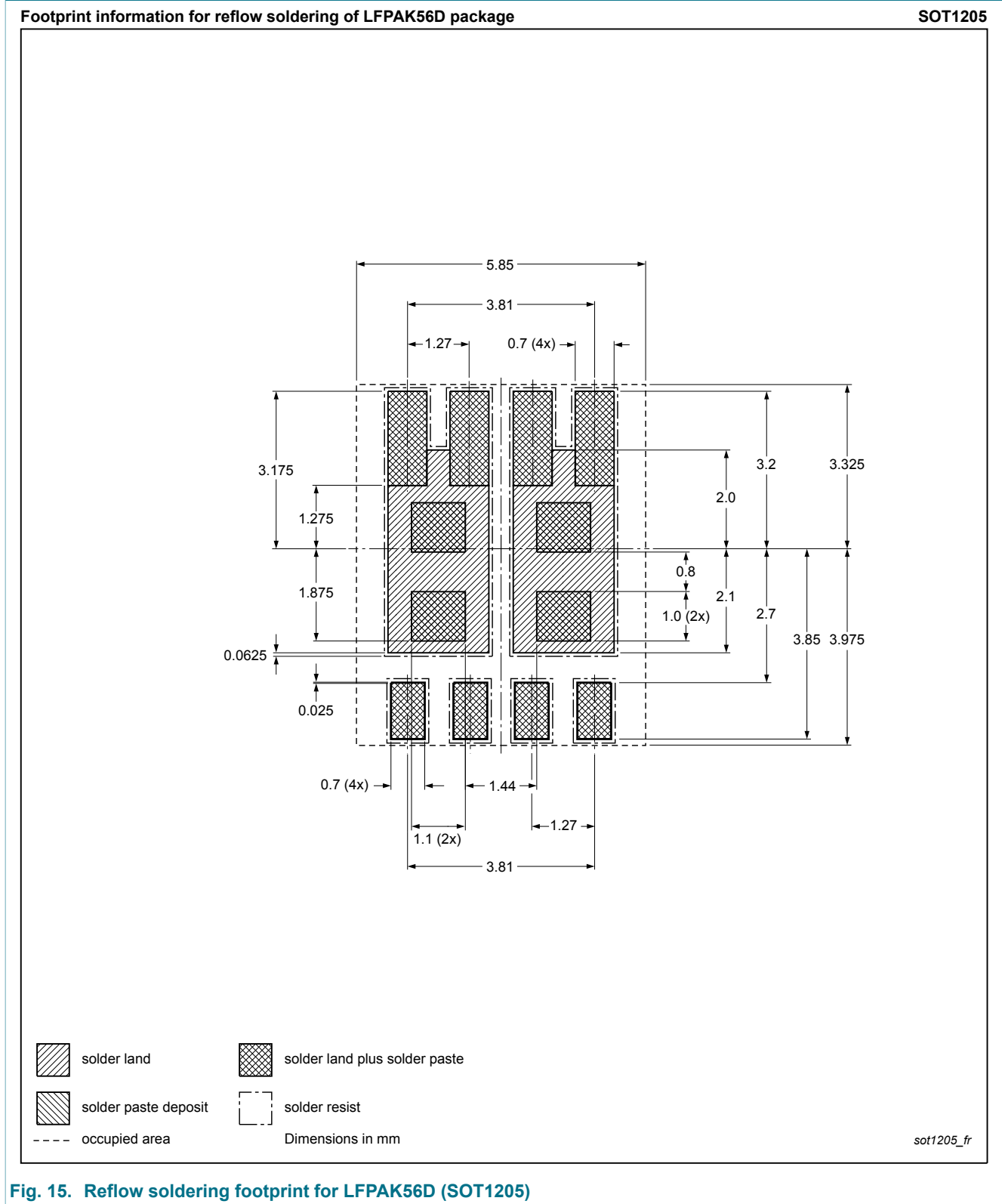


Fig. 15. Reflow soldering footprint for LFPAK56D (SOT1205)

## 14. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PHPT610030PK v.1	20141022	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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[74ALVC125BQ,115](#) [74HC4050N](#) [74HC4514N](#) [MK21FN1M0AVLQ12](#) [MKV30F128VFM10](#) [FRDM-K66F](#) [FRDM-KW40Z](#) [FRDM-MC-](#)  
[LVBLDC](#) [PESD18VF1BSFYL](#) [PMF63UNEX](#) [PSMN4R0-60YS,115](#) [HEF4028BPN](#) [RAPPID-567XFSW](#) [MPC565MVR56](#) [MPC574XG-](#)  
[176DS](#) [MPC8548VJAUJD](#) [MPC860PCVR66D4](#) [BCV61A,215](#) [BFU520XAR](#) [BT137-600E](#) [BT137S-600D.115](#) [BT138-600E.127](#) [BT139X-](#)  
[600.127](#) [BT258-600R.127](#) [BUK7628-100A118](#) [BUK765R0-100E.118](#) [P5020NSE7VNB](#) [S12ZVML12EVBLIN](#) [SCC2692AC1N40](#)  
[LPC1785FBD208K](#) [LPC2124FBD64/01](#) [LS1020ASN7KQB](#) [LS1020AXN7HNB](#) [LS1020AXN7KQB](#) [LS1043ASE7PQA](#)