
# PHPT610030NK-Q

## NPN/NPN high power double bipolar transistor

10 February 2023 Product data sheet

## 1. General description

NPN/NPN high power double bipolar transistor in a SOT1205 (LFPAK56D) Surface-Mounted Device (SMD) power plastic package.

## 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
- Qualified according to AEC-Q101 and recommended for use in automotive applications

## 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 |
|---|---|---|---|---|---|---|---|
| **Per transistor** | | | | | | | |
| $V_{CEO}$ | collector-emitter voltage | open base | | - | - | 100 | V |
| $I_C$ | collector current | | | - | - | 3 | A |
| $R_{CEsat}$ | collector-emitter saturation resistance | $I_C$ = 3 A; $I_B$ = 0.3 A; pulsed; $t_p \leq$ 300 µs; $\delta \leq$ 0.02; $T_{amb}$ = 25 °C | | - | 75 | 110 | mΩ |

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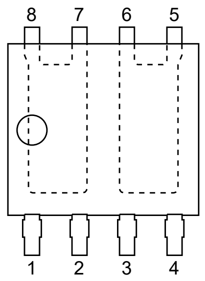
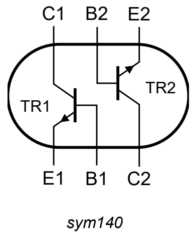
## 5. Pinning information

**Table 2. Pinning information**

| Pin | Symbol | Description | Simplified outline | Graphic symbol |
|---|---|---|---|---|
| 1 | E1 | emitter TR1 |  **LFPAK56D; Dual LFPAK (SOT1205)** |  |
| 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 |
| PHPT610030NK-Q | LFPAK56D; Dual LFPAK | plastic, single ended surface mounted package (LFPAK56D); 8 leads | SOT1205 |

## 7. Marking

**Table 4. Marking codes**

| Type number | Marking code |
|---|---|
| PHPT610030NK-Q | 10030NK |

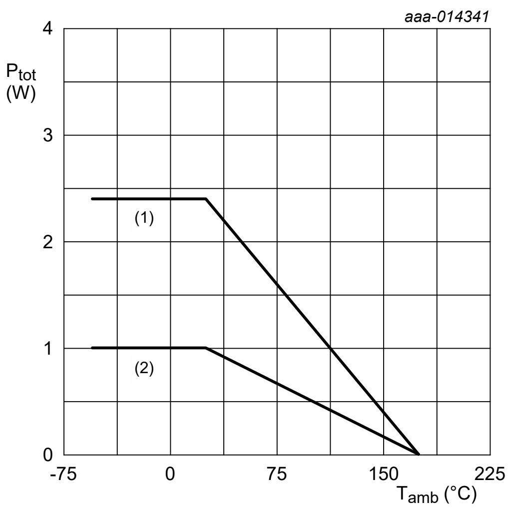
## 8. Limiting values

**Table 5. Limiting values**

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

| Symbol | Parameter | Conditions | | Min | Max | Unit |
|---|---|---|---|---|---|---|
| **Per transistor** | | | | | | |
| $V_{CBO}$ | 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 | | | - | 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 |
| **Per device** | | | | | | |
| $P_{tot}$ | total power dissipation | $T_{amb} \leq$ 25 °C | [1] | - | 1.25 | W |
| | | | [4] | - | 5 | W |
| | | | [2] | - | 3 | 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 $cm^2$.
[3] Power dissipation from junction to mounting base.
[4] Device mounted on a ceramic PCB, $Al_2O_3$, standard footprint.




(1) FR4 PCB, mounting pad for collector 6 $cm^2$
(2) FR4 PCB, standard footprint

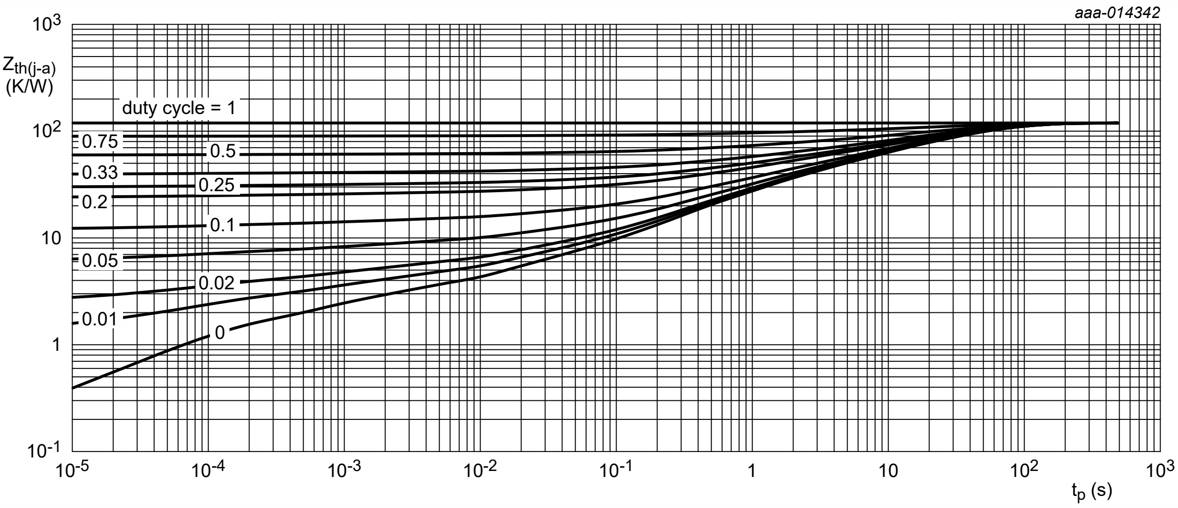
**Fig. 1. Per transistor: power derating curves**

# 9. Thermal characteristics

**Table 6. Thermal characteristics**

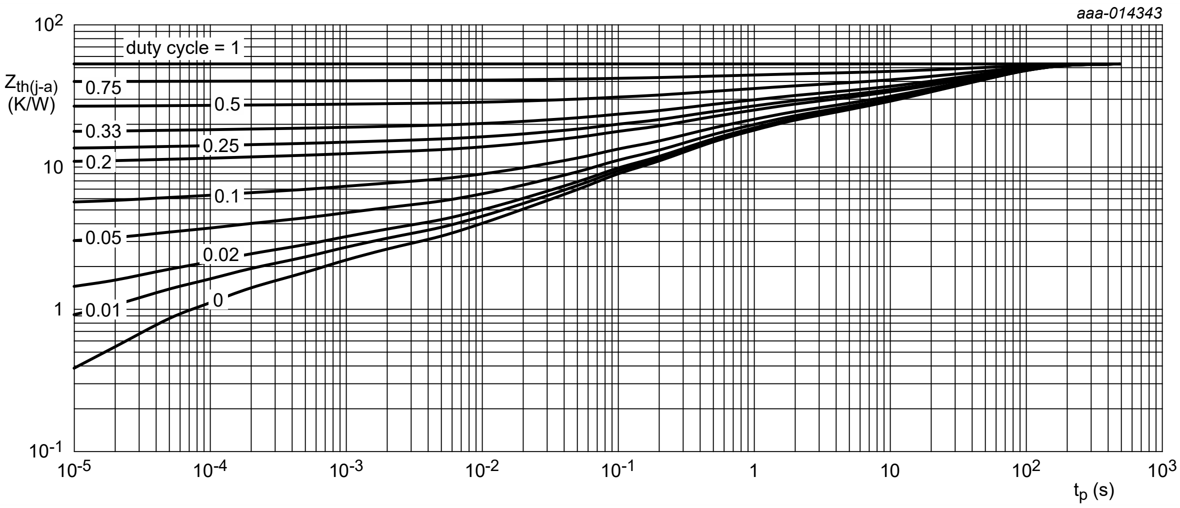
| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **Per transistor** | | | | | | | |
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | in free air | [1] | - | - | 150 | K/W |
| | | | [2] | - | - | 62.5 | K/W |
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point | | | - | - | 6 | K/W |
| **Per device** | | | | | | | |
| $R_{th(j-a)}$ | 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 $cm^2$.
[3] Device mounted on a ceramic PCB, $Al_2O_3$, 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**



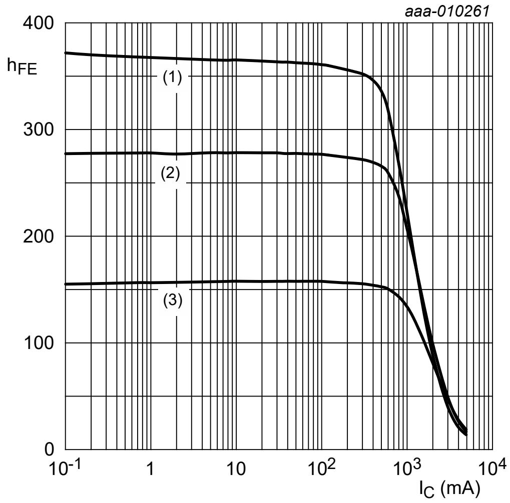

FR4 PCB, mounting pad for collector 6 $cm^2$

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

## 10. Characteristics

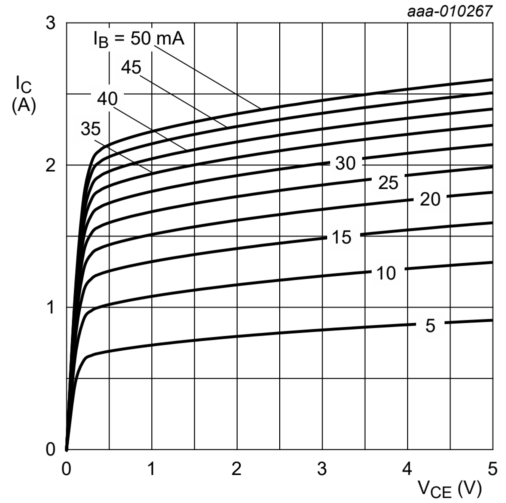
**Table 7. Characteristics**

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **Per transistor** | | | | | | | |
| $I_{CBO}$ | collector-base cut-off current | $V_{CB}$ = 80 V; $I_E$ = 0 A; $T_{amb}$ = 25 °C | | - | - | 100 | nA |
| | | $V_{CB}$ = 80 V; $I_E$ = 0 A; $T_j$ = 150 °C | | - | - | 50 | μA |
| $I_{EBO}$ | emitter-base cut-off current | $V_{EB}$ = 7 V; $I_C$ = 0 A; $T_{amb}$ = 25 °C | | - | - | 100 | nA |
| $I_{CES}$ | collector-emitter cut-off current | $V_{CE}$ = 80 V; $V_{BE}$ = 0 V; $T_{amb}$ = 25 °C | | - | - | 100 | nA |
| $h_{FE}$ | DC current gain | $V_{CE}$ = 10 V; $I_C$ = 500 mA; pulsed; $t_p \leq$ 300 μs; $\delta \leq$ 0.02; $T_{amb}$ = 25 °C | | 150 | 250 | - | |
| | | $V_{CE}$ = 10 V; $I_C$ = 1 A; pulsed; $t_p \leq$ 300 μs; $\delta \leq$ 0.02; $T_{amb}$ = 25 °C | | 80 | 250 | - | |
| | | $V_{CE}$ = 10 V; $I_C$ = 2 A; pulsed; $t_p \leq$ 300 μs; $\delta \leq$ 0.02; $T_{amb}$ = 25 °C | | 20 | 100 | - | |
| | | $V_{CE}$ = 10 V; $I_C$ = 3 A; pulsed; $t_p \leq$ 300 μs; $\delta \leq$ 0.02; $T_{amb}$ = 25 °C | | 10 | 40 | - | |
| $V_{CEsat}$ | collector-emitter saturation voltage | $I_C$ = 1 A; $I_B$ = 50 mA; pulsed; $t_p \leq$ 300 μs; $\delta \leq$ 0.02; $T_{amb}$ = 25 °C | | - | 90 | 150 | mV |
| | | $I_C$ = 3 A; $I_B$ = 300 mA; pulsed; $t_p \leq$ 300 μs; $\delta \leq$ 0.02; $T_{amb}$ = 25 °C | | - | 225 | 330 | mV |
| $R_{CEsat}$ | collector-emitter saturation resistance | $I_C$ = 3 A; $I_B$ = 0.3 A; pulsed; $t_p \leq$ 300 μs; $\delta \leq$ 0.02; $T_{amb}$ = 25 °C | | - | 75 | 110 | mΩ |
| $V_{BEsat}$ | base-emitter saturation voltage | $I_C$ = 1 A; $I_B$ = 50 mA; pulsed; $t_p \leq$ 300 μs; $\delta \leq$ 0.02; $T_{amb}$ = 25 °C | | - | 0.86 | 1 | V |
| | | $I_C$ = 2 A; $I_B$ = 200 mA; pulsed; $t_p \leq$ 300 μs; $\delta \leq$ 0.02; $T_{amb}$ = 25 °C | | - | 1 | 1.2 | V |
| $V_{BEon}$ | base-emitter turn-on voltage | $V_{CE}$ = 2 V; $I_C$ = 0.1 A; pulsed; $t_p \leq$ 300 μs; $\delta \leq$ 0.02; $T_{amb}$ = 25 °C | | - | 0.67 | 0.85 | V |
| $t_d$ | delay time | $V_{CC}$ = 12.5 V; $I_C$ = 1 A; $I_{Bon}$ = 50 mA; $I_{Boff}$ = -50 mA; $T_{amb}$ = 25 °C | | - | 20 | - | ns |
| $t_r$ | rise time | | | - | 300 | - | ns |
| $t_{on}$ | turn-on time | | | - | 320 | - | ns |
| $t_s$ | storage time | | | - | 830 | - | ns |
| $t_f$ | fall time | | | - | 470 | - | ns |
| $t_{off}$ | turn-off time | | | - | 1300 | - | ns |
| $f_T$ | transition frequency | $V_{CE}$ = 10 V; $I_C$ = 100 mA; f = 100 MHz; $T_{amb}$ = 25 °C | | - | 140 | - | MHz |
| $C_c$ | collector capacitance | $V_{CB}$ = 10 V; $I_E$ = 0 A; $i_e$ = 0 A; f = 1 MHz; $T_{amb}$ = 25 °C | | - | 11 | - | pF |



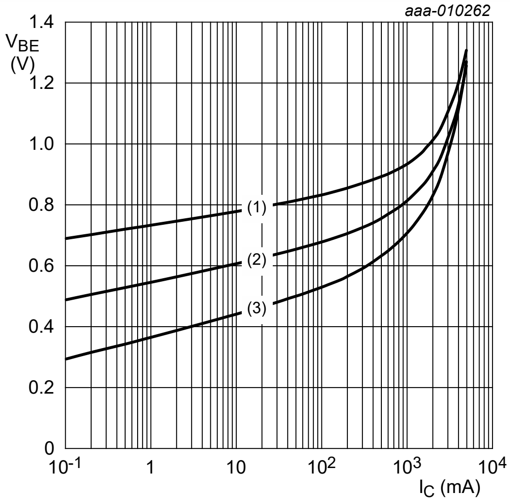

$V_{CE}$ = 10 V
(1) $T_{amb}$ = 100 °C
(2) $T_{amb}$ = 25 °C
(3) $T_{amb}$ = −55 °C

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



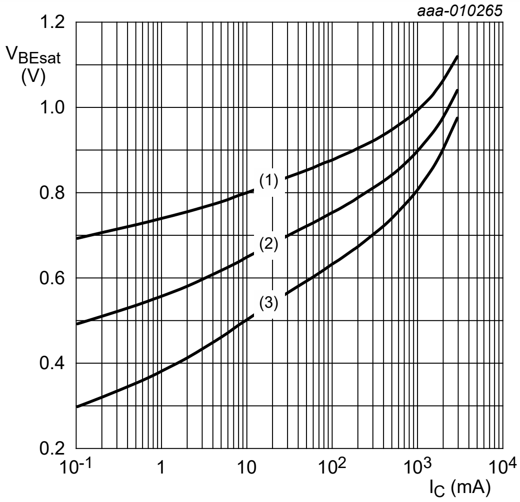

$T_{amb}$ = 25 °C

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



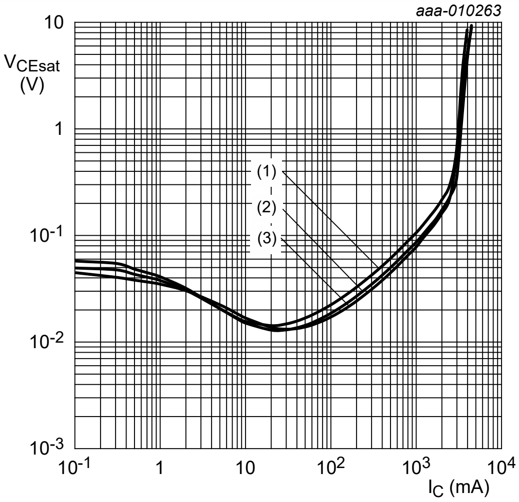

$V_{CE}$ = 2 V
(1) $T_{amb}$ = −55 °C
(2) $T_{amb}$ = 25 °C
(3) $T_{amb}$ = 100 °C

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



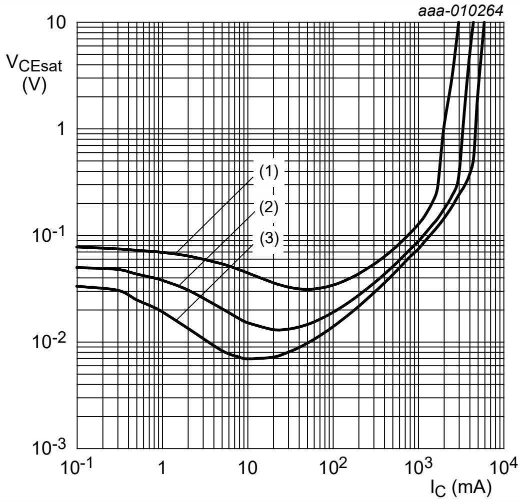

$I_C/I_B$ = 20
(1) $T_{amb}$ = −55 °C
(2) $T_{amb}$ = 25 °C
(3) $T_{amb}$ = 100 °C

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



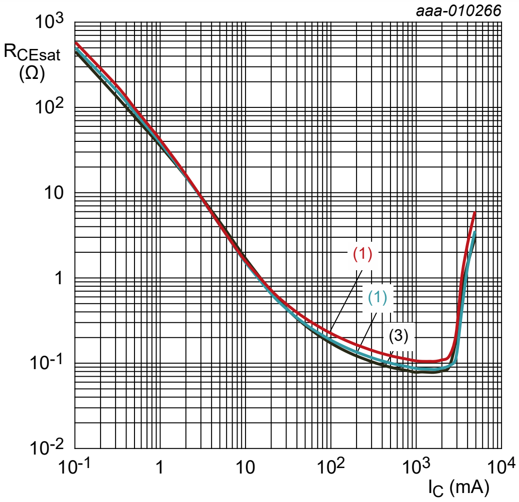

$I_C/I_B = 20$
(1) $T_{amb} = 100$ °C
(2) $T_{amb} = 25$ °C
(3) $T_{amb} = -55$ °C

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



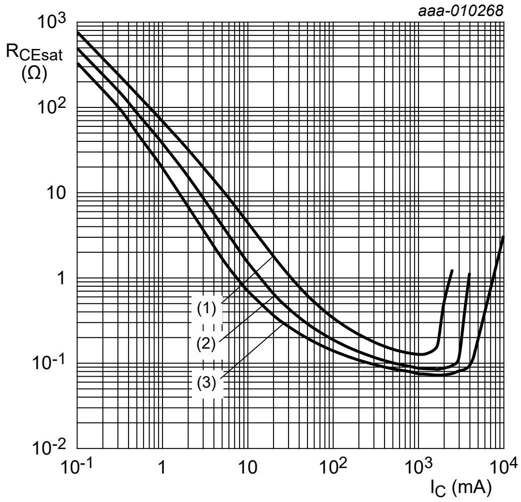

$T_{amb} = 25$ °C
(1) $I_C/I_B = 50$
(2) $I_C/I_B = 20$
(3) $I_C/I_B = 10$

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




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

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




$T_{amb} = 25$ °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

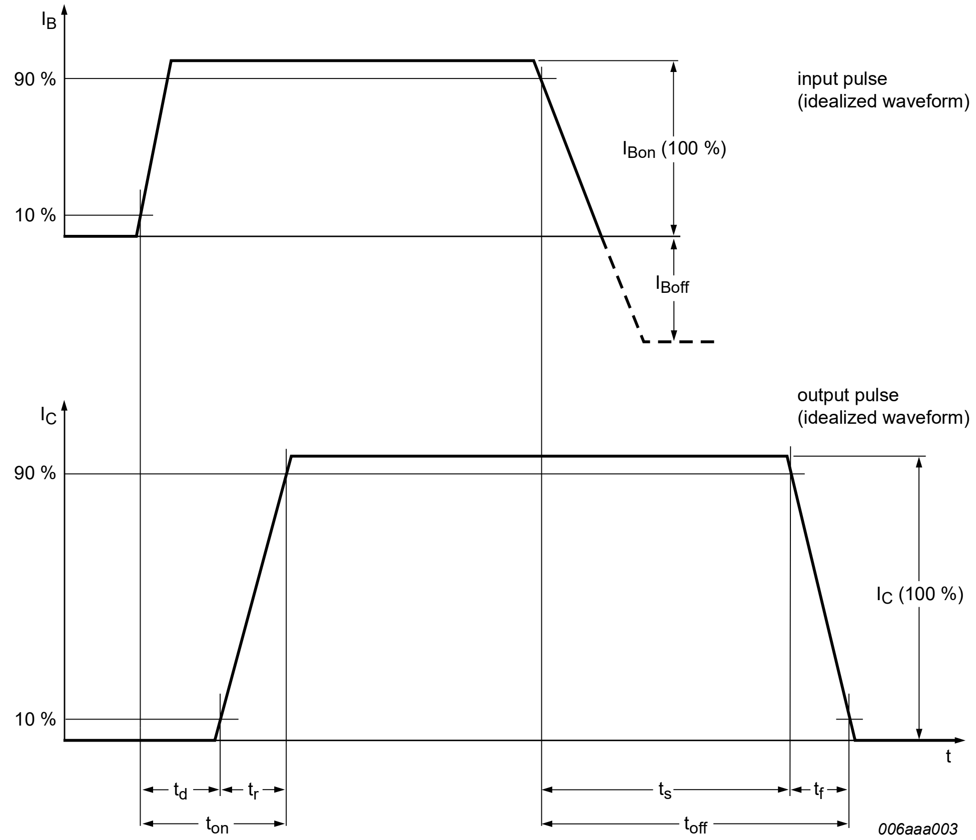



**Fig. 12. Switching time definition**

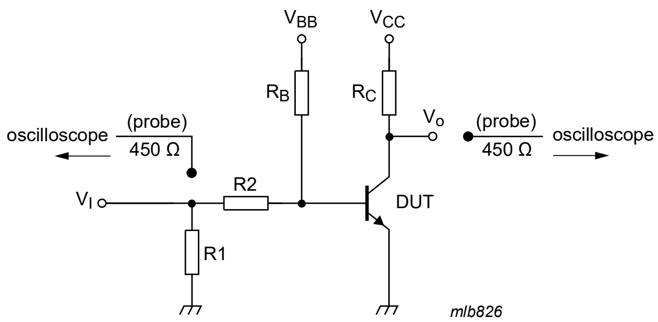


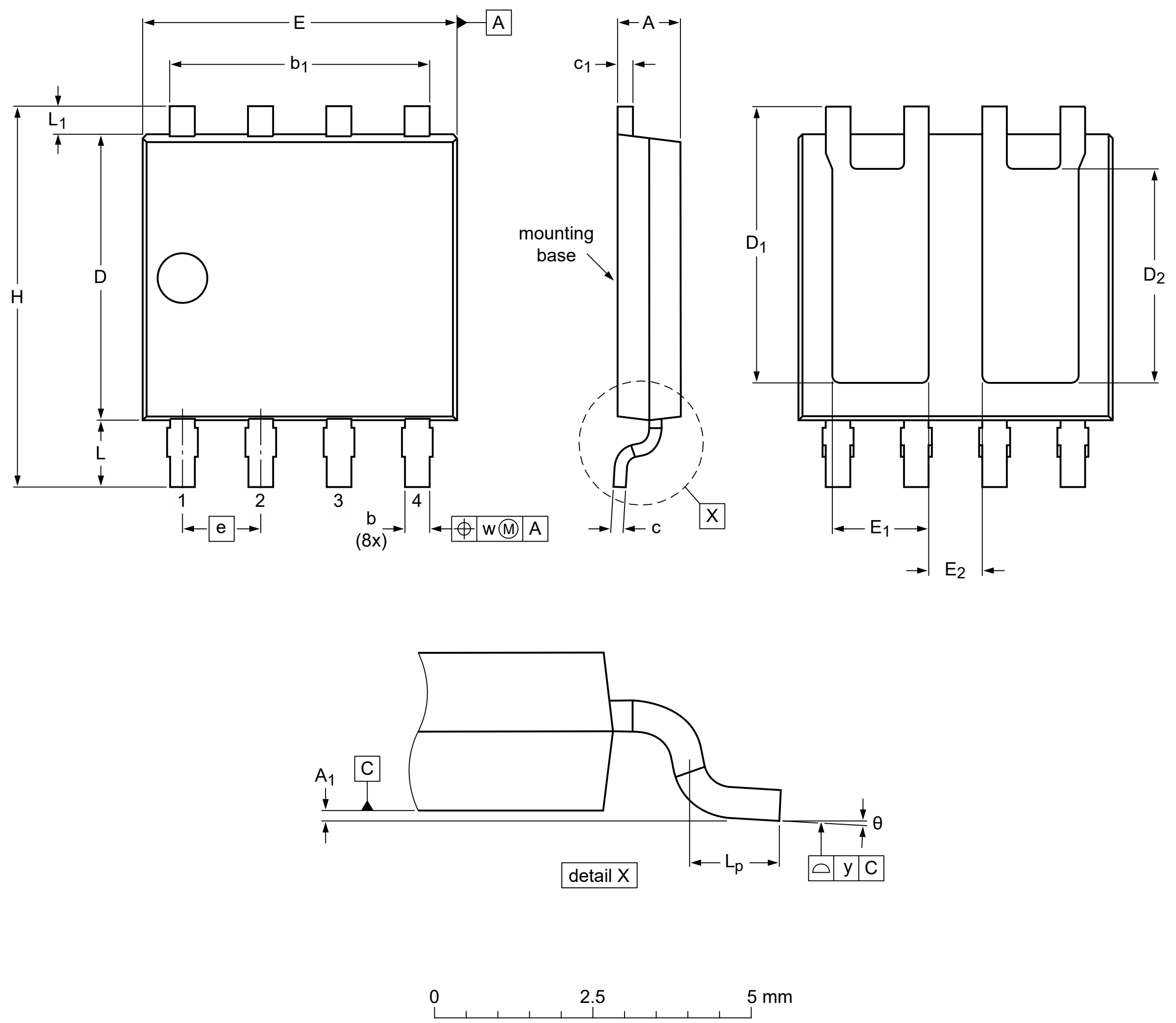

**Fig. 13. Test circuit for switching times**

## 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 LFPAK56D; 8 leads** **SOT1205**




Dimensions

| Unit | | A | $A_1$ | b | $b_1$ | c | $c_1$ | $D^{(1)}$ | $D_1^{(1)}$ | $D_2$ (ref) | $E^{(1)}$ | $E_1^{(1)}$ | $E_2$ | e | H | L | $L_1$ | $L_p$ | w | y | θ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | max | 1.05 | 0.1 | 0.50 | 4.4 | 0.25 | 0.30 | 4.70 | 4.55 | 3.5 | 5.30 | 1.8 | 0.85 | | 6.2 | 1.3 | 0.55 | 0.85 | | | 8° |
| | nom | | | | | | | | | | | | | 1.27 | | | | | 0.25 | 0.1 | |
| | min | 1.02 | 0.0 | 0.35 | 4.1 | 0.19 | 0.24 | 4.45 | 4.35 | 3.4 | 4.95 | 1.6 | 0.60 | | 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 | | | | | | ~~14-08-21~~ 14-10-28 |

**Fig. 14. Package outline LFPAK56D; Dual LFPAK (SOT1205)**

## 13. Soldering

**Footprint information for reflow soldering of LFPAK56D package** **SOT1205**

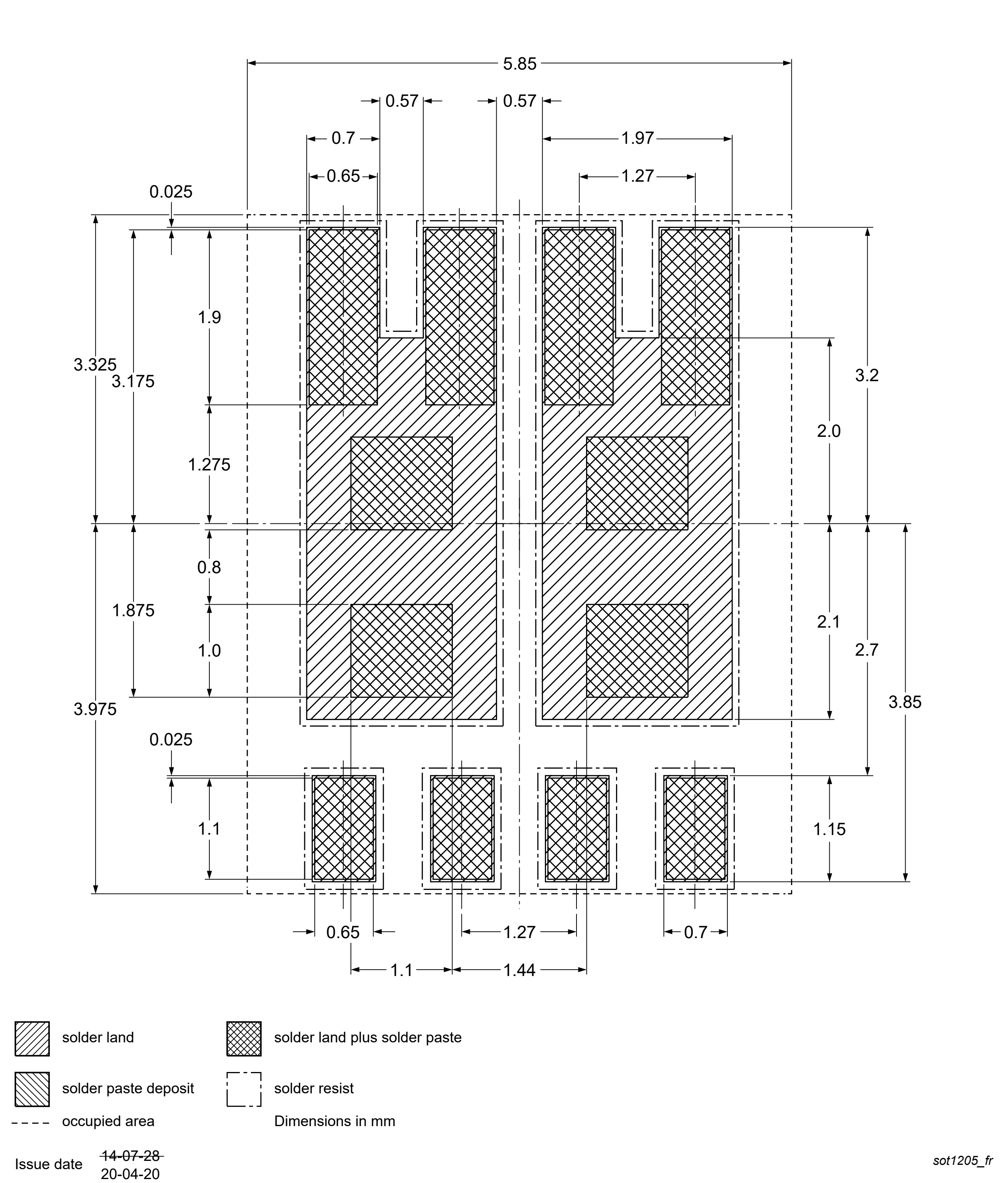



**Fig. 15. Reflow soldering footprint for LFPAK56D; Dual LFPAK (SOT1205)**

## 14. Revision history

**Table 8. Revision history**

| Data sheet ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| PHPT610030NK-Q v.1 | 20230210 | 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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**Date of release: 10 February 2023**