



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

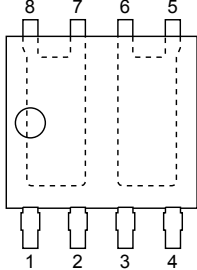
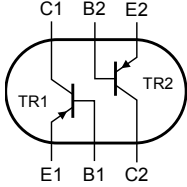
4. Quick reference data

Table 1. Quick reference data

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

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

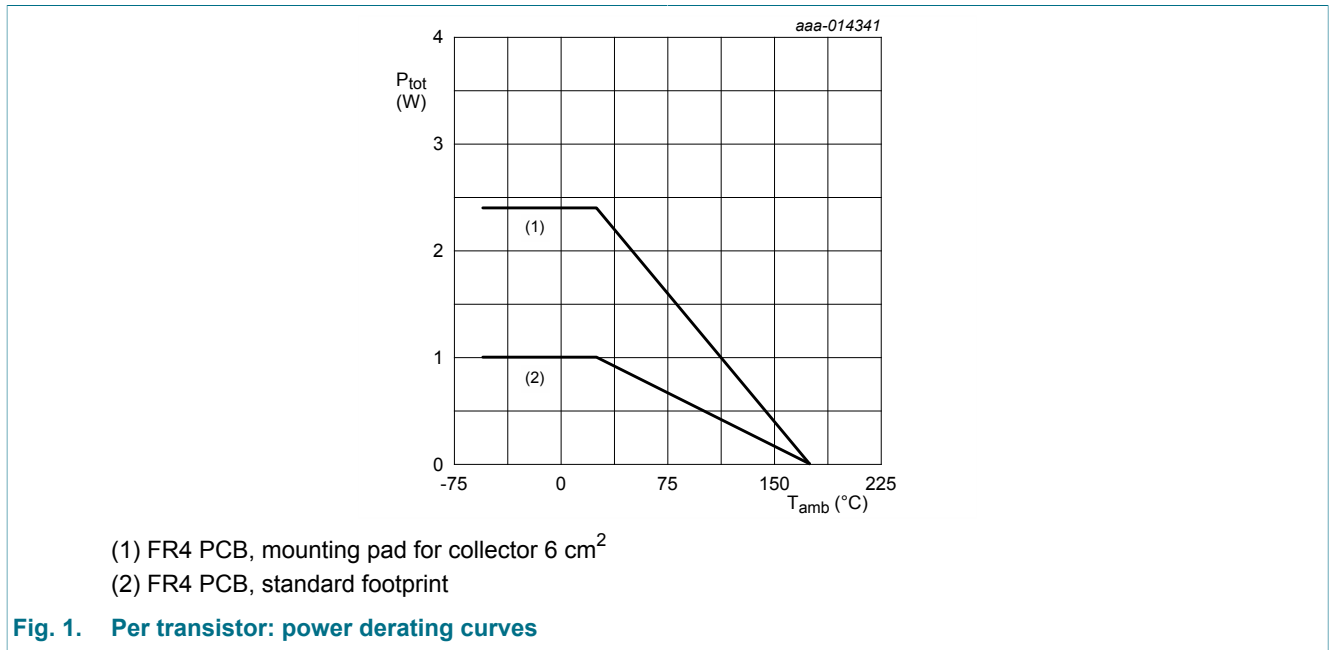
Table 5. Limiting values

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

| Symbol | Parameter | Conditions | Min | Max | Unit |
|-----------------------|---------------------------|-------------------------------|-----|------|------|
| 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 | - | -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 _{tot} | total power dissipation | T _{amb} ≤ 25 °C | [1] | - | 1 | W |
| | | | [2] | - | 2.4 | W |
| | | | [3] | - | 25 | W |
| Per device | | | | | | |
| P _{tot} | total power dissipation | T _{amb} ≤ 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 cm².
- [3] Power dissipation from junction to mounting base.
- [4] Device mounted on a ceramic PCB, Al₂O₃, standard footprint.

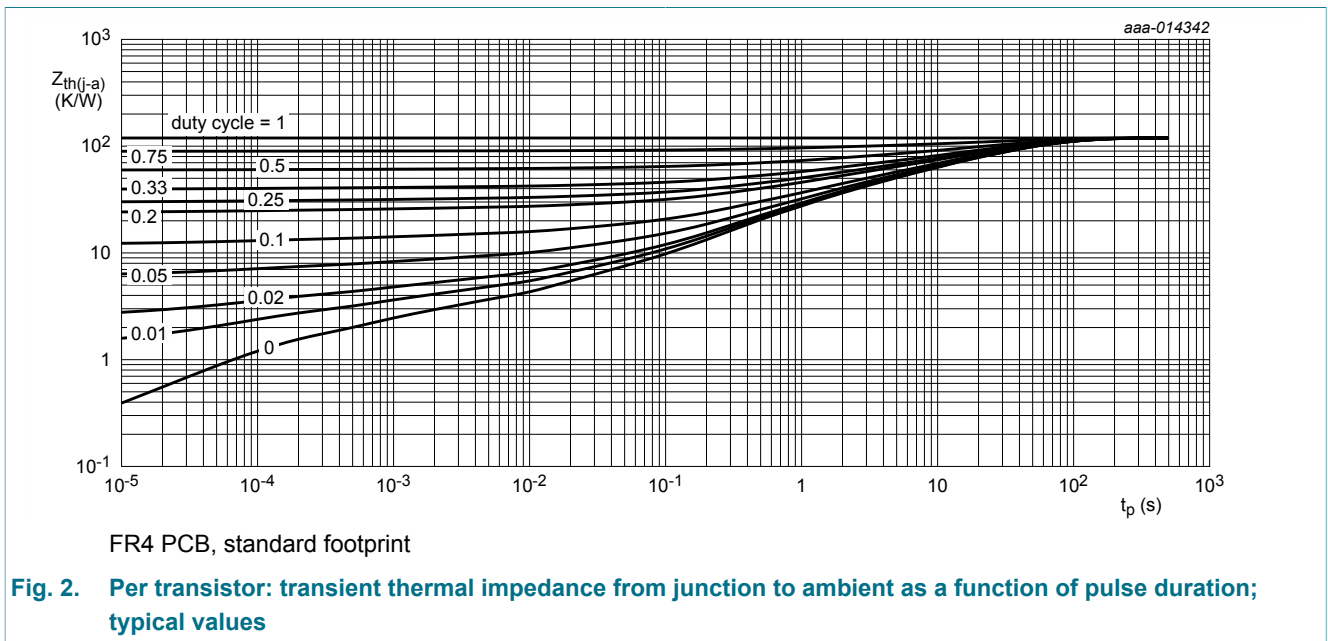


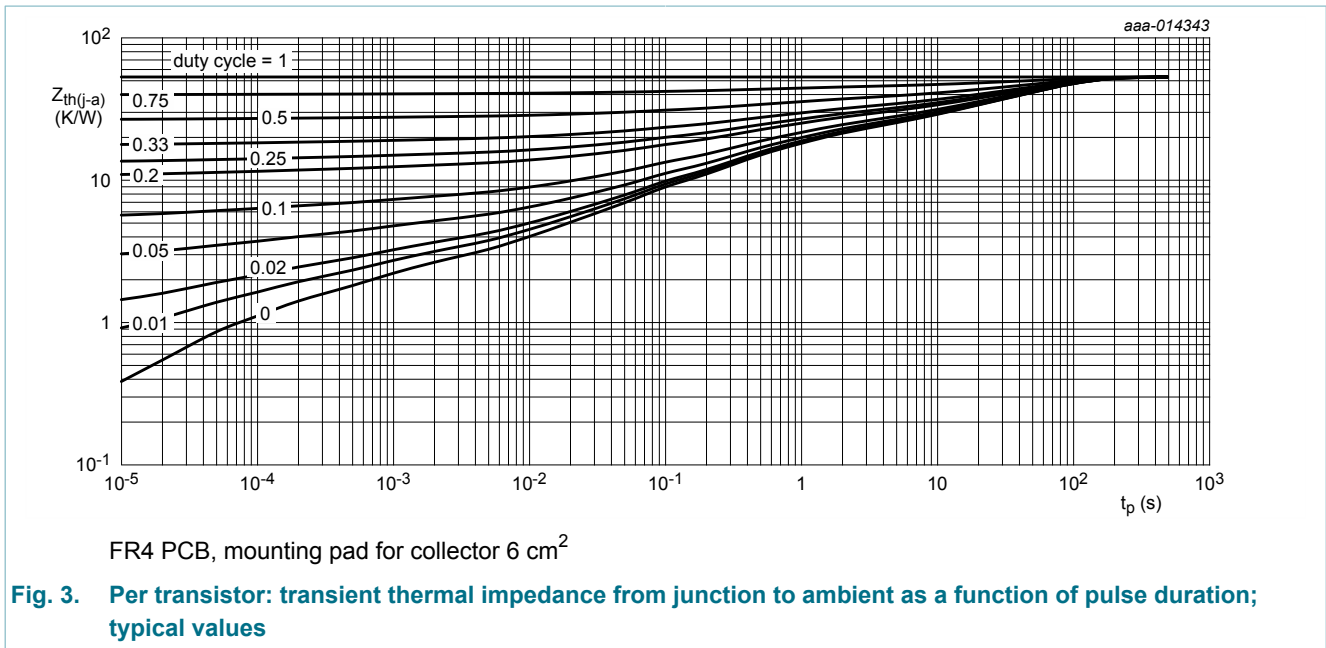
9. Thermal characteristics

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 cm².
- [3] Device mounted on a ceramic PCB, Al₂O₃, standard footprint.



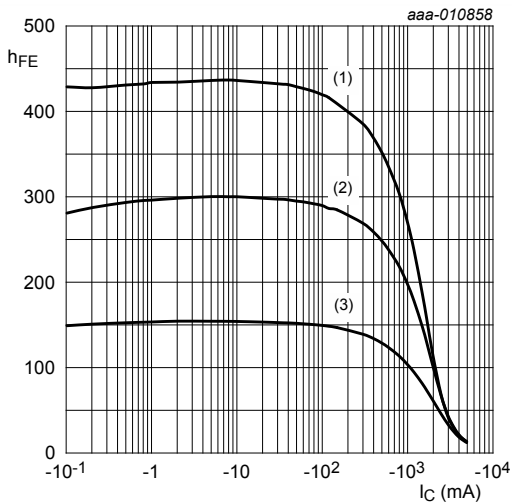


10. Characteristics

Table 7. Characteristics

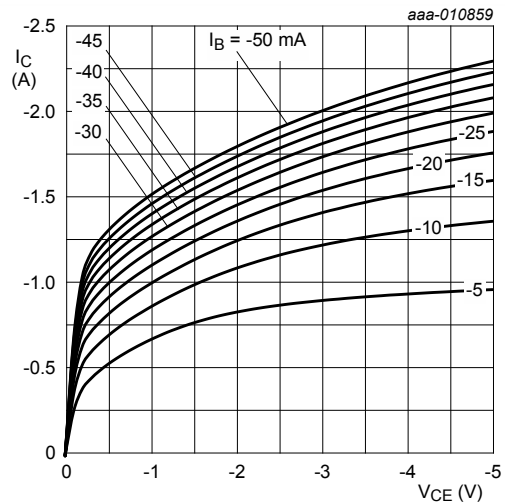
| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|-----------------------|--------------------------------------|--|-----|------|------|------|
| Per transistor | | | | | | |
| I _{CBO} | collector-base cut-off current | V _{CB} = -80 V; I _E = 0 A; T _{amb} = 25 °C | - | - | -100 | nA |
| | | V _{CB} = -80 V; I _E = 0 A; T _j = 150 °C | - | - | -50 | μA |
| I _{CES} | collector-emitter cut-off current | V _{CE} = -80 V; V _{BE} = 0 V; T _{amb} = 25 °C | - | - | -100 | nA |
| I _{EBO} | emitter-base cut-off current | V _{EB} = -7 V; I _C = 0 A; T _{amb} = 25 °C | - | - | -100 | nA |
| h _{FE} | DC current gain | V _{CE} = -10 V; I _C = -500 mA; T _{amb} = 25 °C | 150 | 220 | - | |
| | | V _{CE} = -10 V; I _C = -1 A; pulsed; t _p ≤ 300 μs; δ ≤ 0.02; T _{amb} = 25 °C | 80 | 210 | - | |
| | | V _{CE} = -10 V; I _C = -2 A; pulsed; t _p ≤ 300 μs; δ ≤ 0.02; T _{amb} = 25 °C | 20 | 100 | - | |
| | | V _{CE} = -10 V; I _C = -3 A; pulsed; t _p ≤ 300 μs; δ ≤ 0.02; T _{amb} = 25 °C | 10 | 40 | - | |
| V _{CEsat} | collector-emitter saturation voltage | I _C = -500 mA; I _B = -50 mA; T _{amb} = 25 °C | - | -70 | -110 | mV |
| | | I _C = -2 A; I _B = -200 mA; pulsed; t _p ≤ 300 μs; δ ≤ 0.02; T _{amb} = 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 Ω |
| 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 |



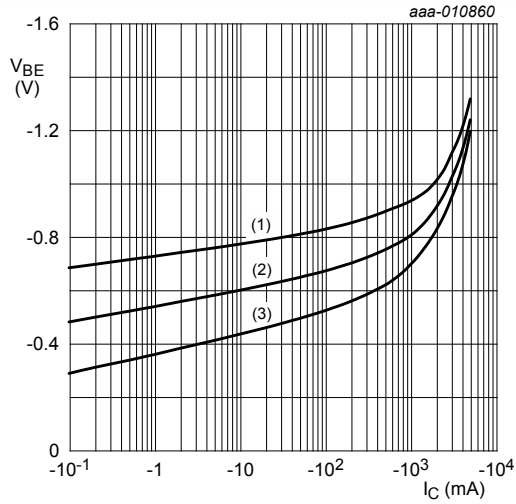
$V_{CE} = -10\text{ V}$
 (1) $T_{amb} = 100\text{ }^\circ\text{C}$
 (2) $T_{amb} = 25\text{ }^\circ\text{C}$
 (3) $T_{amb} = -55\text{ }^\circ\text{C}$

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



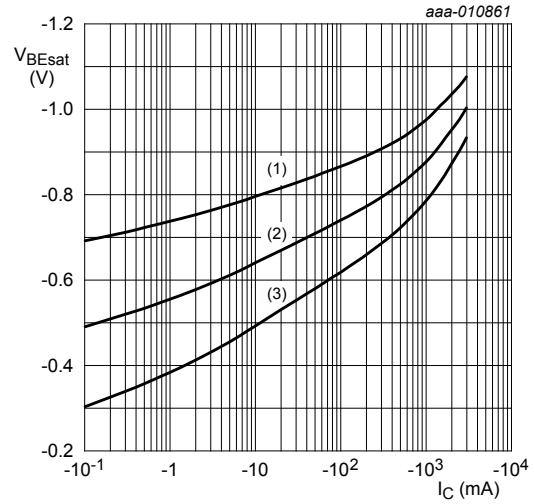
$T_{amb} = 25\text{ }^\circ\text{C}$

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



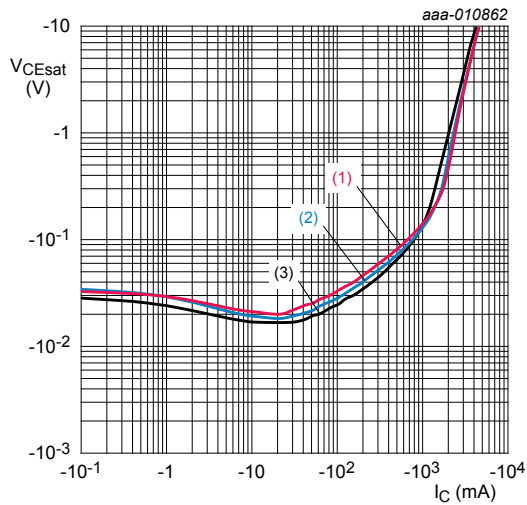
$V_{CE} = -2 \text{ V}$
 (1) $T_{amb} = -55 \text{ }^\circ\text{C}$
 (2) $T_{amb} = 25 \text{ }^\circ\text{C}$
 (3) $T_{amb} = 100 \text{ }^\circ\text{C}$

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



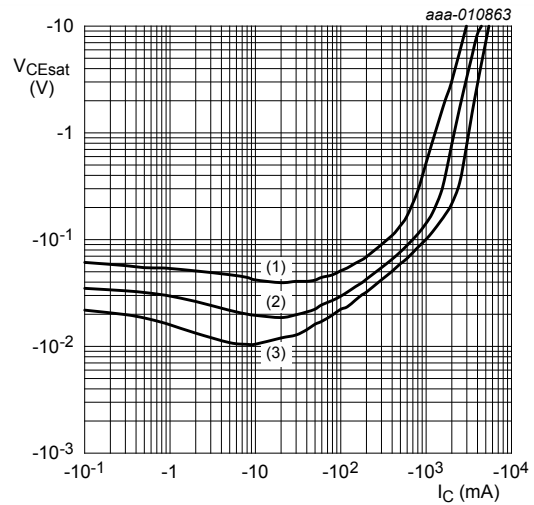
$I_C/I_B = 20$
 (1) $T_{amb} = -55 \text{ }^\circ\text{C}$
 (2) $T_{amb} = 25 \text{ }^\circ\text{C}$
 (3) $T_{amb} = 100 \text{ }^\circ\text{C}$

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



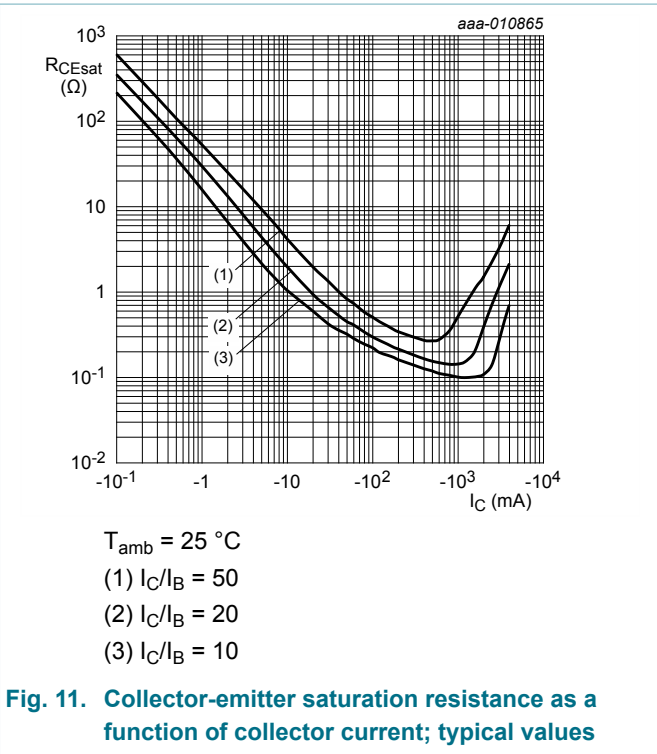
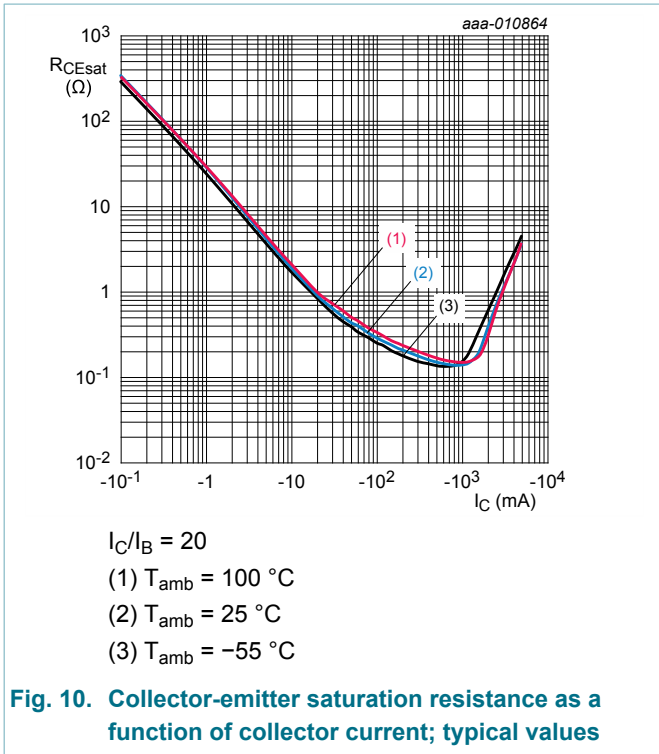
$I_C/I_B = 20$
 (1) $T_{amb} = 100 \text{ }^\circ\text{C}$
 (2) $T_{amb} = 25 \text{ }^\circ\text{C}$
 (3) $T_{amb} = -55 \text{ }^\circ\text{C}$

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



11. Test information

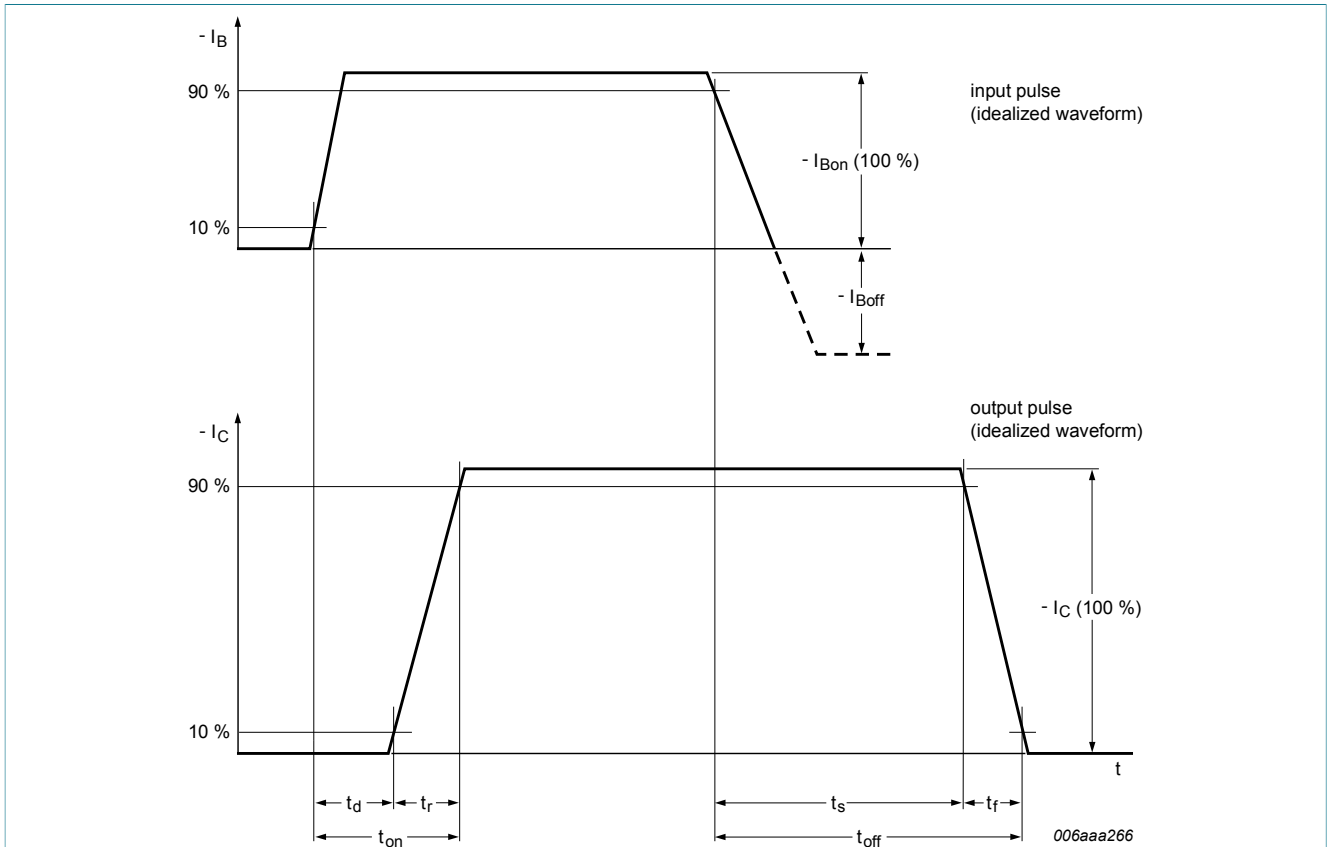


Fig. 12. BISS transistor switching time definition

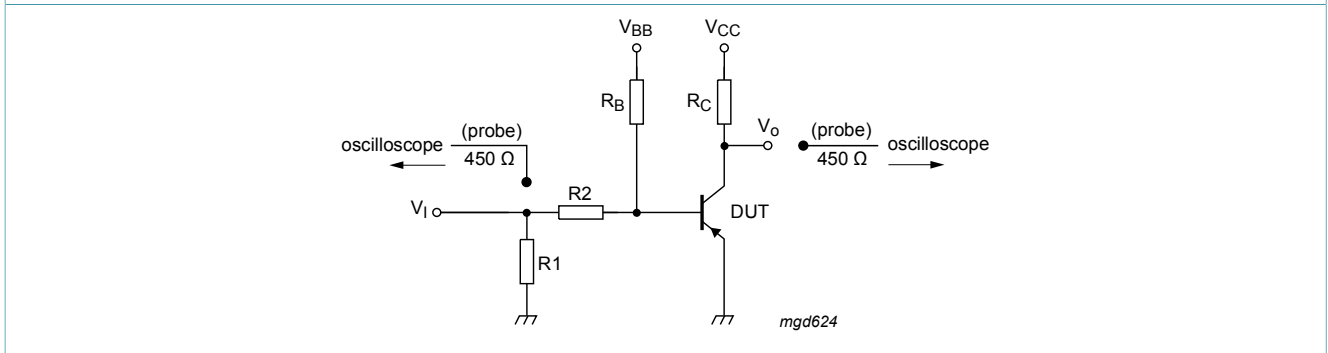


Fig. 13. Test circuit for switching times

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

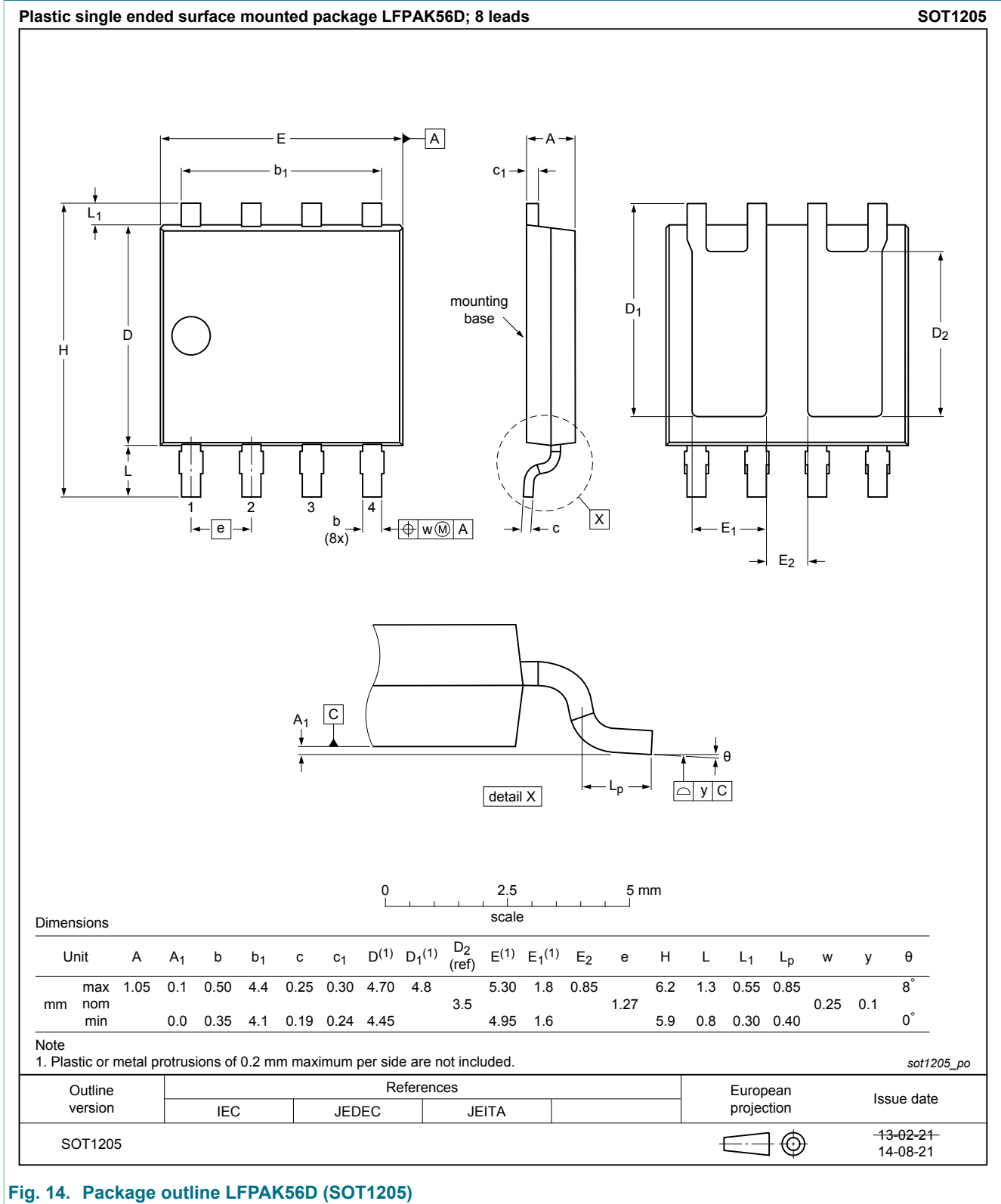


Fig. 14. Package outline LFPAK56D (SOT1205)

13. Soldering

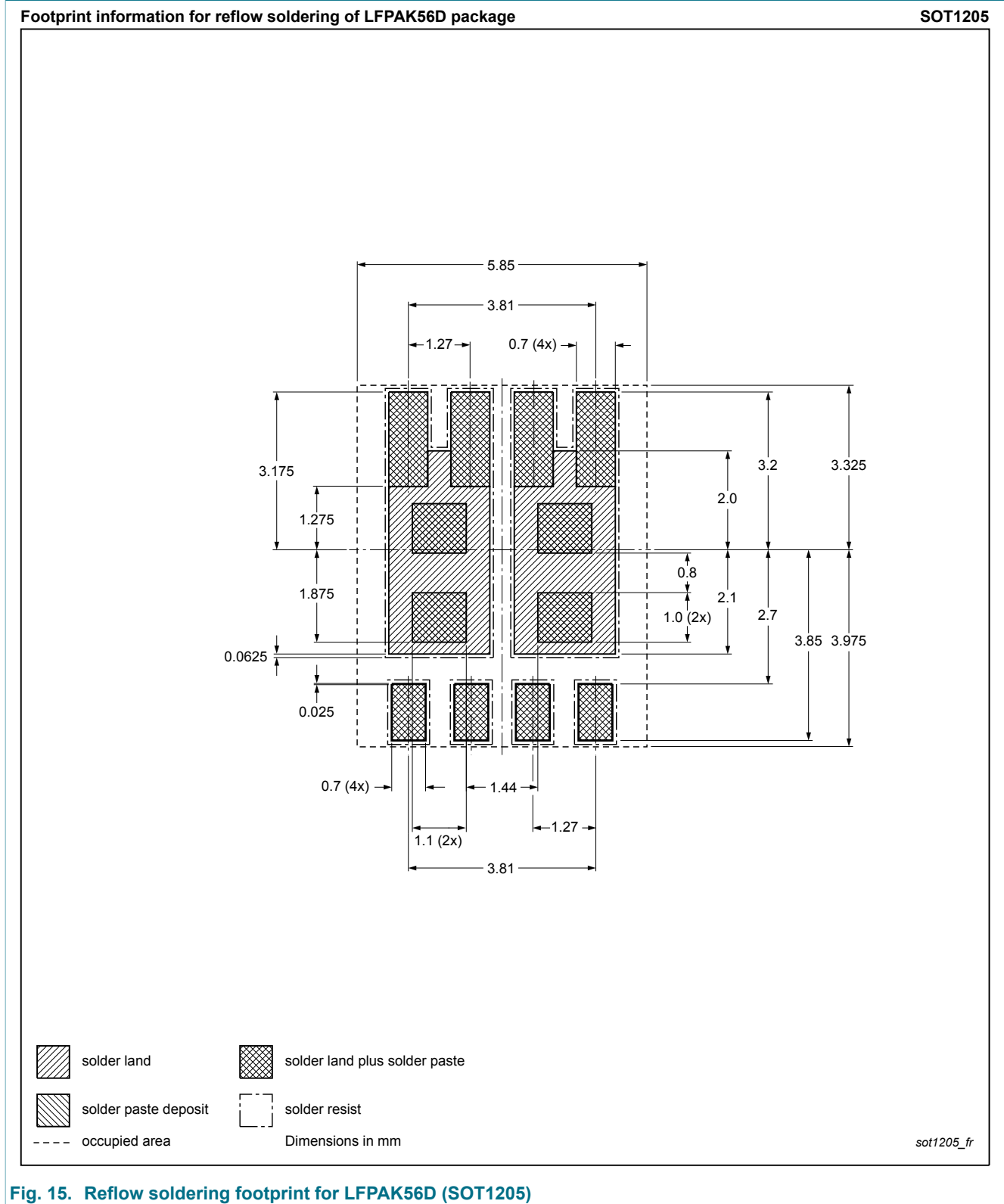


Fig. 15. Reflow soldering footprint for LFPAK56D (SOT1205)

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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