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Kind regards,

Team Nexperia

PDTC124E series

NPN resistor-equipped transistors;
R1 = 22 k Ω , R2 = 22 k Ω

Rev. 8 — 28 November 2011

Product data sheet

1. Product profile

1.1 General description

NPN Resistor-Equipped Transistor (RET) family in Surface-Mounted Device (SMD) plastic packages.

Table 1. Product overview

| Type number | Package | | | PNP complement | Package configuration |
|-------------|---------|--------|----------|----------------|-----------------------|
| | NXP | JEITA | JEDEC | | |
| PDTC124EE | SOT416 | SC-75 | - | PDTA124EE | ultra small |
| PDTC124EM | SOT883 | SC-101 | - | PDTA124EM | leadless ultra small |
| PDTC124ET | SOT23 | - | TO-236AB | PDTA124ET | small |
| PDTC124EU | SOT323 | SC-70 | - | PDTA124EU | very small |

1.2 Features and benefits

- 100 mA output current capability
- Built-in bias resistors
- Simplifies circuit design
- Reduces component count
- Reduces pick and place costs
- AEC-Q101 qualified

1.3 Applications

- Digital applications in automotive and industrial segments
- Control of IC inputs
- Cost-saving alternative for BC847/857 series in digital applications
- Switching loads

1.4 Quick reference data

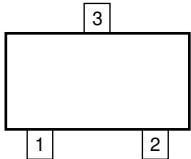
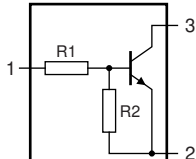
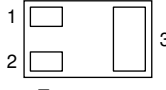
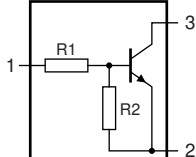
Table 2. Quick reference data

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|------------------|---------------------------|------------|------|-----|------|------------|
| V _{CEO} | collector-emitter voltage | open base | - | - | 50 | V |
| I _O | output current | | - | - | 100 | mA |
| R1 | bias resistor 1 (input) | | 15.4 | 22 | 28.6 | k Ω |
| R2/R1 | bias resistor ratio | | 0.8 | 1 | 1.2 | |



2. Pinning information

Table 3. Pinning

| Pin | Description | Simplified outline | Graphic symbol |
|------------------------------|--------------------|---|---|
| SOT23; SOT323; SOT416 | | | |
| 1 | input (base) |  <p>006aaa144</p> |  <p>sym007</p> |
| 2 | GND (emitter) | | |
| 3 | output (collector) | | |
| SOT883 | | | |
| 1 | input (base) |  <p>Transparent top view</p> |  <p>sym007</p> |
| 2 | GND (emitter) | | |
| 3 | output (collector) | | |

3. Ordering information

Table 4. Ordering information

| Type number | Package | | |
|-------------|---------|---|---------|
| | Name | Description | Version |
| PDTC124EE | SC-75 | plastic surface-mounted package; 3 leads | SOT416 |
| PDTC124EM | SC-101 | leadless ultra small plastic package; 3 solder lands; body 1.0 × 0.6 × 0.5 mm | SOT883 |
| PDTC124ET | - | plastic surface-mounted package; 3 leads | SOT23 |
| PDTC124EU | SC-70 | plastic surface-mounted package; 3 leads | SOT323 |

4. Marking

Table 5. Marking codes

| Type number | Marking code ^[1] |
|-------------|-----------------------------|
| PDTC124EE | 06 |
| PDTC124EM | DX |
| PDTC124ET | *17 |
| PDTC124EU | *06 |

[1] * = placeholder for manufacturing site code

5. Limiting values

Table 6. Limiting values

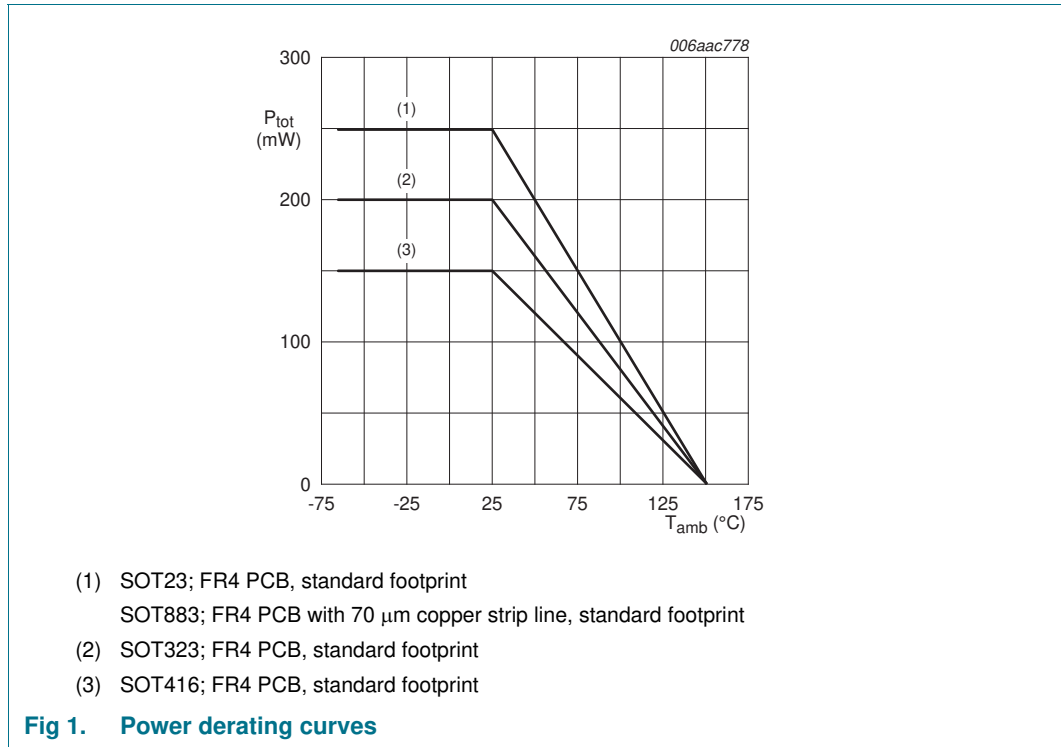
In accordance with the Absolute Maximum Rating System (IEC 60134).

| Symbol | Parameter | Conditions | Min | Max | Unit | |
|------------------|---------------------------|--|--------|------|------|----|
| V _{CBO} | collector-base voltage | open emitter | - | 50 | V | |
| V _{CEO} | collector-emitter voltage | open base | - | 50 | V | |
| V _{EBO} | emitter-base voltage | open collector | - | 10 | V | |
| V _I | input voltage | | | | | |
| | positive | | - | +40 | V | |
| | negative | | - | -10 | V | |
| I _O | output current | | - | 100 | mA | |
| I _{CM} | peak collector current | single pulse; t _p ≤ 1 ms | - | 100 | mA | |
| P _{tot} | total power dissipation | T _{amb} ≤ 25 °C | | | | |
| | PDTC124EE (SOT416) | | [1][2] | - | 150 | mW |
| | PDTC124EM (SOT883) | | [2][3] | - | 250 | mW |
| | PDTC124ET (SOT23) | | [1] | - | 250 | mW |
| | PDTC124EU (SOT323) | | [1] | - | 200 | mW |
| T _j | junction temperature | | - | 150 | °C | |
| T _{amb} | ambient temperature | | -65 | +150 | °C | |
| T _{stg} | storage temperature | | -65 | +150 | °C | |

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

[2] Reflow soldering is the only recommended soldering method.

[3] Device mounted on an FR4 PCB with 70 μ m copper strip line, standard footprint.



6. Thermal characteristics

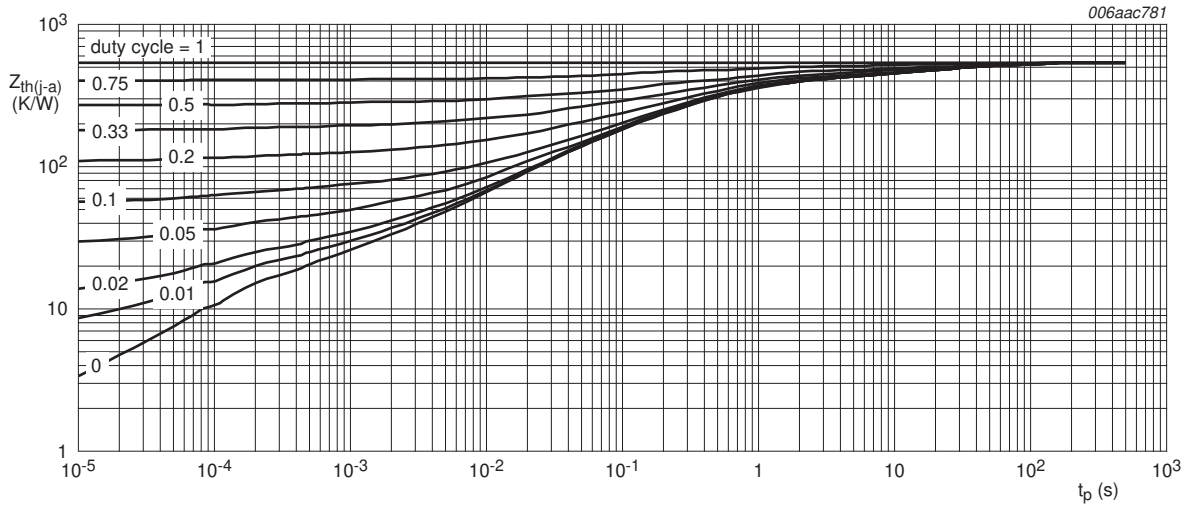
Table 7. Thermal characteristics

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|----------------------|---|-------------|-----|-----|-----|------|
| R _{th(j-a)} | thermal resistance from junction to ambient | in free air | | | | |
| | PDTC124EE (SOT416) | [1][2] | - | - | 830 | K/W |
| | PDTC124EM (SOT883) | [2][3] | - | - | 500 | K/W |
| | PDTC124ET (SOT23) | [1] | - | - | 500 | K/W |
| | PDTC124EU (SOT323) | [1] | - | - | 625 | K/W |

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

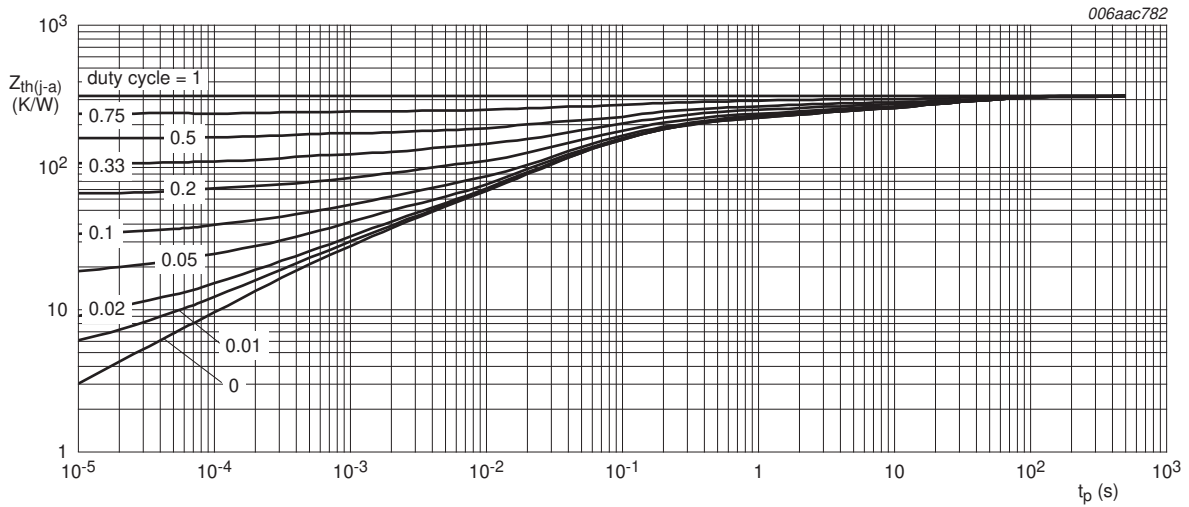
[2] Reflow soldering is the only recommended soldering method.

[3] Device mounted on an FR4 PCB with 70 μm copper strip line, standard footprint.



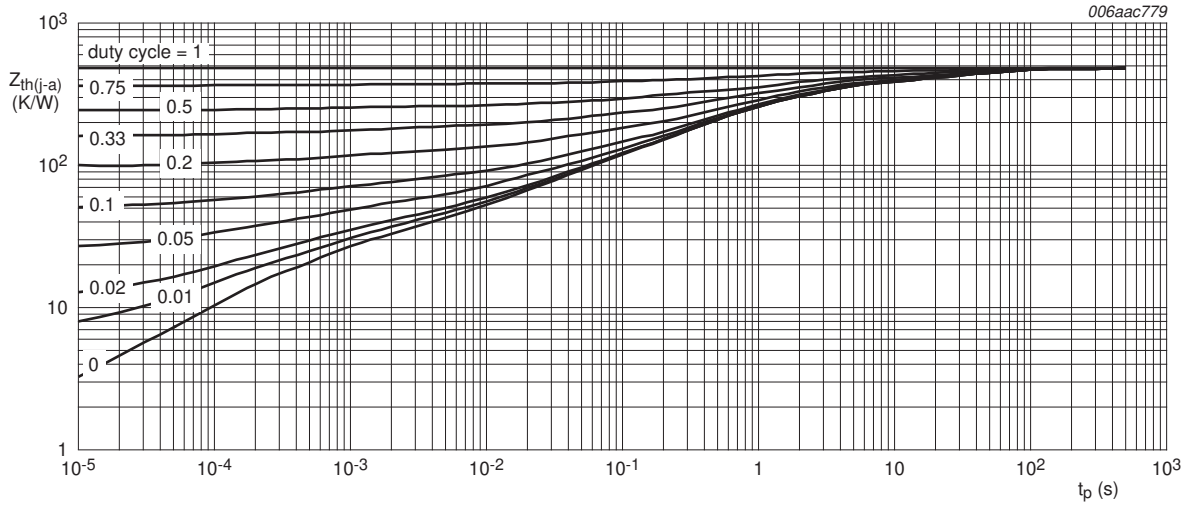
FR4 PCB, standard footprint

Fig 2. Transient thermal impedance from junction to ambient as a function of pulse duration for PDTC124EE (SOT416); typical values



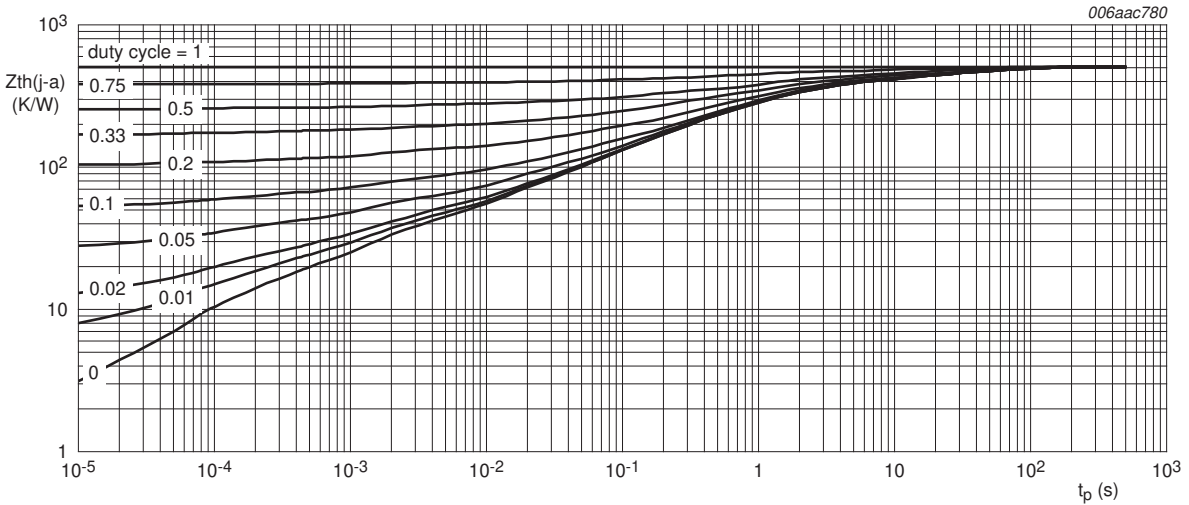
FR4 PCB, 70 μm copper strip line

Fig 3. Transient thermal impedance from junction to ambient as a function of pulse duration for PDTC124EM (SOT883); typical values



FR4 PCB, standard footprint

Fig 4. Transient thermal impedance from junction to ambient as a function of pulse duration for PDTC124ET (SOT23); typical values



FR4 PCB, standard footprint

Fig 5. Transient thermal impedance from junction to ambient as a function of pulse duration for PDTC124EU (SOT323); typical values

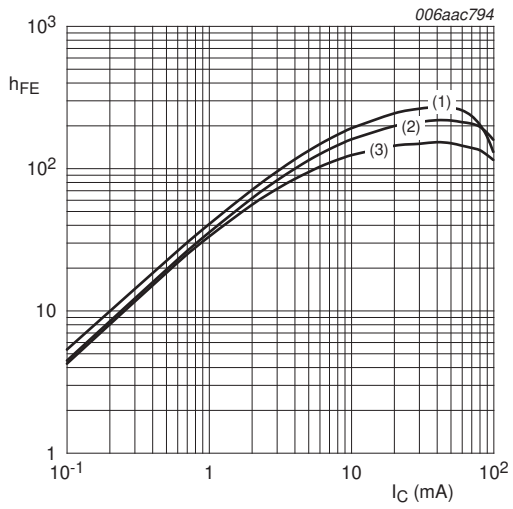
7. Characteristics

Table 8. Characteristics

$T_{amb} = 25\text{ }^{\circ}\text{C}$ unless otherwise specified.

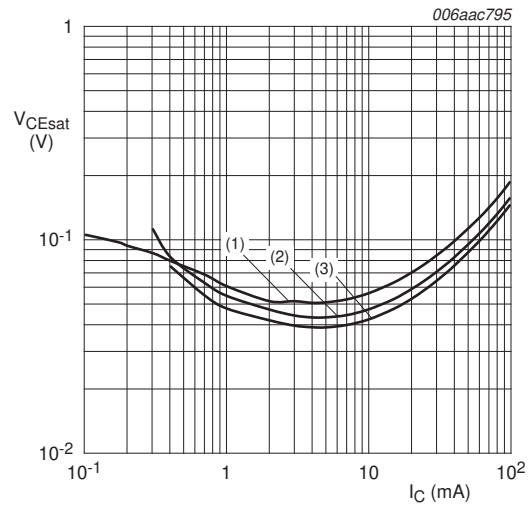
| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------------|--------------------------------------|---|------|-----|------|---------------|
| I_{CBO} | collector-base cut-off current | $V_{CB} = 50\text{ V}; I_E = 0\text{ A}$ | - | - | 100 | nA |
| I_{CEO} | collector-emitter cut-off current | $V_{CE} = 30\text{ V}; I_B = 0\text{ A}$ | - | - | 100 | nA |
| | | $V_{CE} = 30\text{ V}; I_B = 0\text{ A}; T_j = 150\text{ }^{\circ}\text{C}$ | - | - | 5 | μA |
| I_{EBO} | emitter-base cut-off current | $V_{EB} = 5\text{ V}; I_C = 0\text{ A}$ | - | - | 180 | μA |
| h_{FE} | DC current gain | $V_{CE} = 5\text{ V}; I_C = 5\text{ mA}$ | 60 | - | - | |
| V_{CEsat} | collector-emitter saturation voltage | $I_C = 10\text{ mA}; I_B = 0.5\text{ mA}$ | - | - | 150 | mV |
| $V_{I(off)}$ | off-state input voltage | $V_{CE} = 5\text{ V}; I_C = 100\text{ }\mu\text{A}$ | - | 1.1 | 0.8 | V |
| $V_{I(on)}$ | on-state input voltage | $V_{CE} = 0.3\text{ V}; I_C = 5\text{ mA}$ | 2.5 | 1.7 | - | V |
| R1 | bias resistor 1 (input) | | 15.4 | 22 | 28.6 | k Ω |
| R2/R1 | bias resistor ratio | | 0.8 | 1 | 1.2 | |
| C_c | collector capacitance | $V_{CB} = 10\text{ V}; I_E = I_e = 0\text{ A}; f = 1\text{ MHz}$ | - | - | 2.5 | pF |
| f_T | transition frequency | $V_{CE} = 5\text{ V}; I_C = 10\text{ mA}; f = 100\text{ MHz}$ | [1] | - | 230 | MHz |

[1] Characteristics of built-in transistor



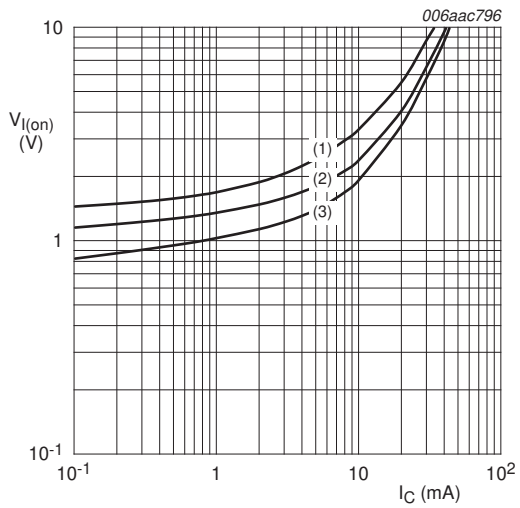
$V_{CE} = 5 \text{ V}$
 (1) $T_{amb} = 100 \text{ }^\circ\text{C}$
 (2) $T_{amb} = 25 \text{ }^\circ\text{C}$
 (3) $T_{amb} = -40 \text{ }^\circ\text{C}$

Fig 6. DC current gain as a function of collector current; typical values



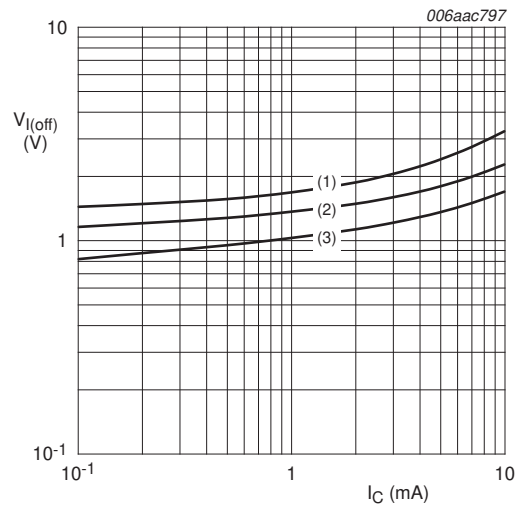
$I_C/I_B = 20$
 (1) $T_{amb} = 100 \text{ }^\circ\text{C}$
 (2) $T_{amb} = 25 \text{ }^\circ\text{C}$
 (3) $T_{amb} = -40 \text{ }^\circ\text{C}$

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



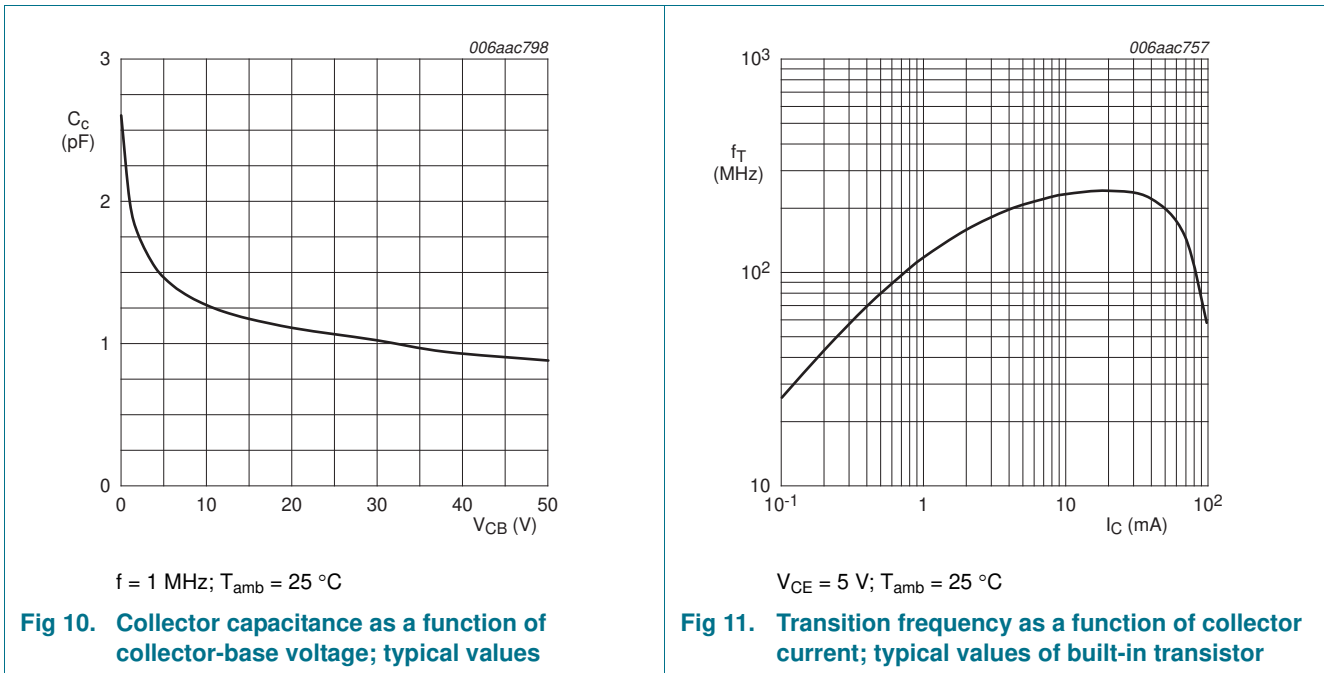
$V_{CE} = 0.3 \text{ V}$
 (1) $T_{amb} = -40 \text{ }^\circ\text{C}$
 (2) $T_{amb} = 25 \text{ }^\circ\text{C}$
 (3) $T_{amb} = 100 \text{ }^\circ\text{C}$

Fig 8. On-state input voltage as a function of collector current; typical values



$V_{CE} = 5 \text{ V}$
 (1) $T_{amb} = -40 \text{ }^\circ\text{C}$
 (2) $T_{amb} = 25 \text{ }^\circ\text{C}$
 (3) $T_{amb} = 100 \text{ }^\circ\text{C}$

Fig 9. Off-state input voltage as a function of collector current; typical values

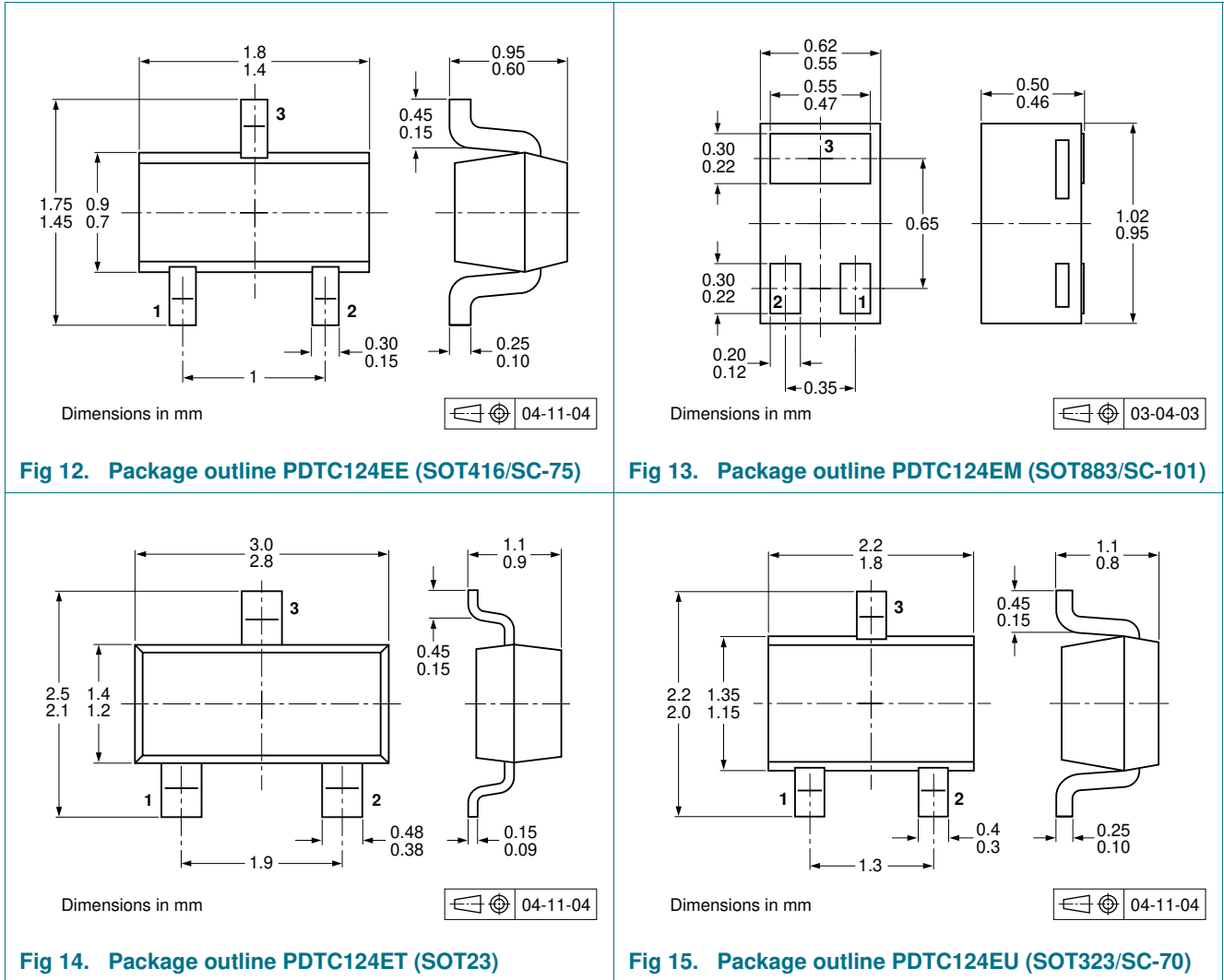


8. Test information

8.1 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.

9. Package outline



10. Packing information

Table 9. Packing methods

The indicated -xxx are the last three digits of the 12NC ordering code.^[1]

| Type number | Package | Description | Packing quantity | | |
|-------------|---------|--------------------------------|------------------|------|-------|
| | | | 3000 | 5000 | 10000 |
| PDTC124EE | SOT416 | 4 mm pitch, 8 mm tape and reel | -115 | - | -135 |
| PDTC124EM | SOT883 | 2 mm pitch, 8 mm tape and reel | - | - | -315 |
| PDTC124ET | SOT23 | 4 mm pitch, 8 mm tape and reel | -215 | - | -235 |
| PDTC124EU | SOT323 | 4 mm pitch, 8 mm tape and reel | -115 | - | -135 |

[1] For further information and the availability of packing methods, see [Section 14](#).

11. Soldering

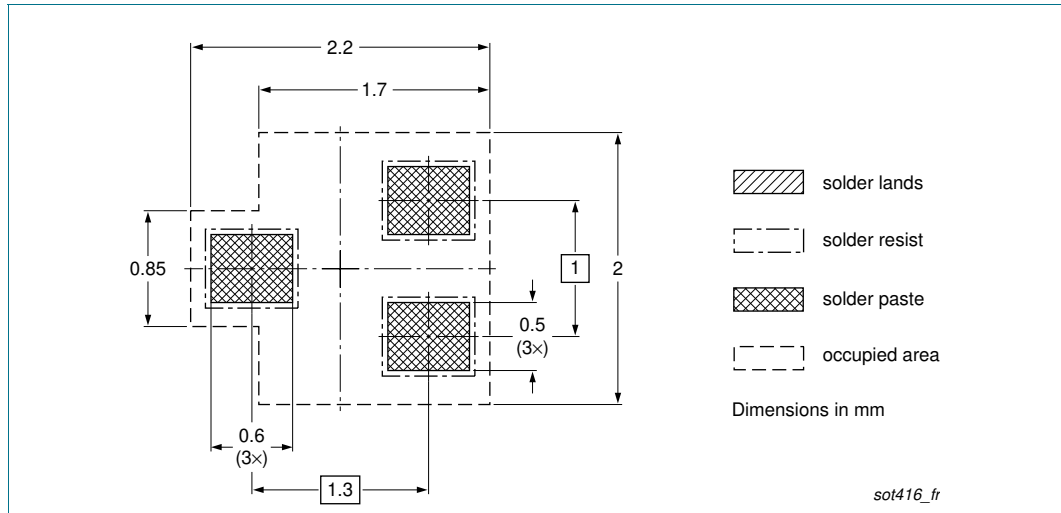


Fig 16. Reflow soldering footprint PDTC124EE (SOT416/SC-75)

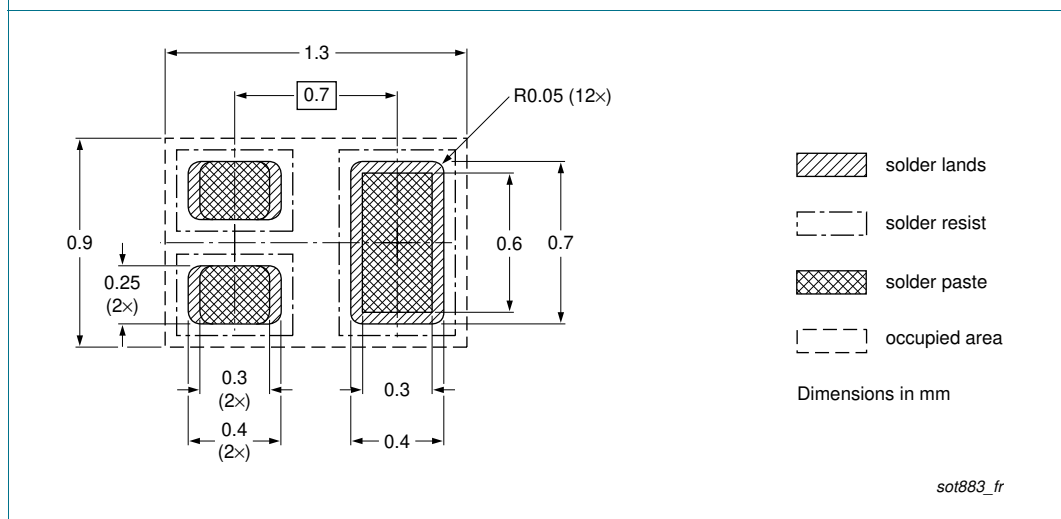


Fig 17. Reflow soldering footprint PDTC124EM (SOT883/SC-101)

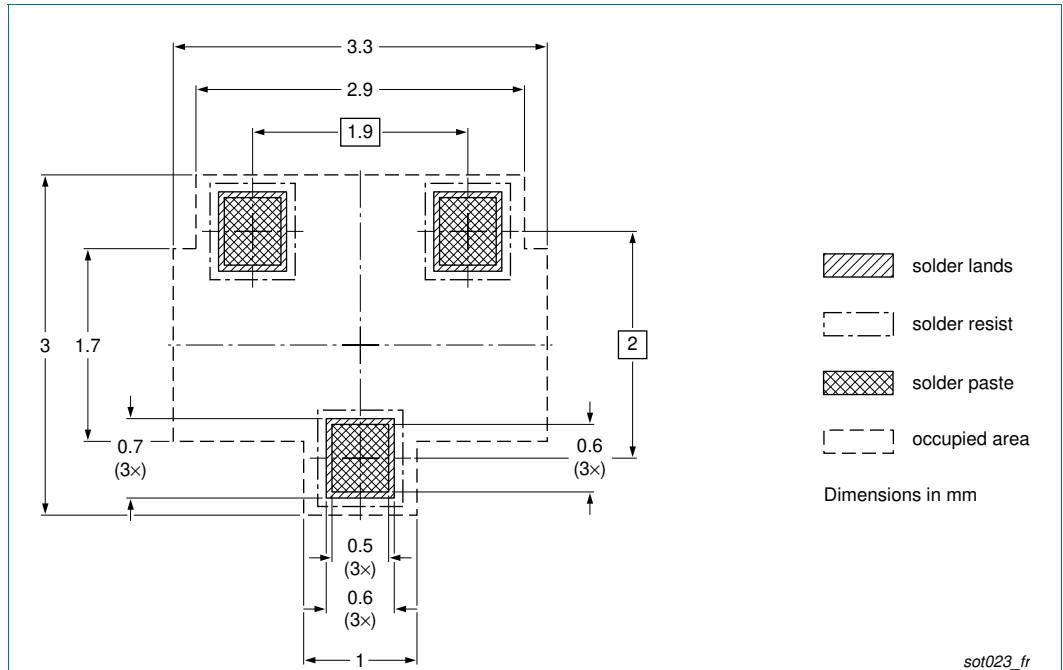


Fig 18. Reflow soldering footprint PDTC124ET (SOT23)

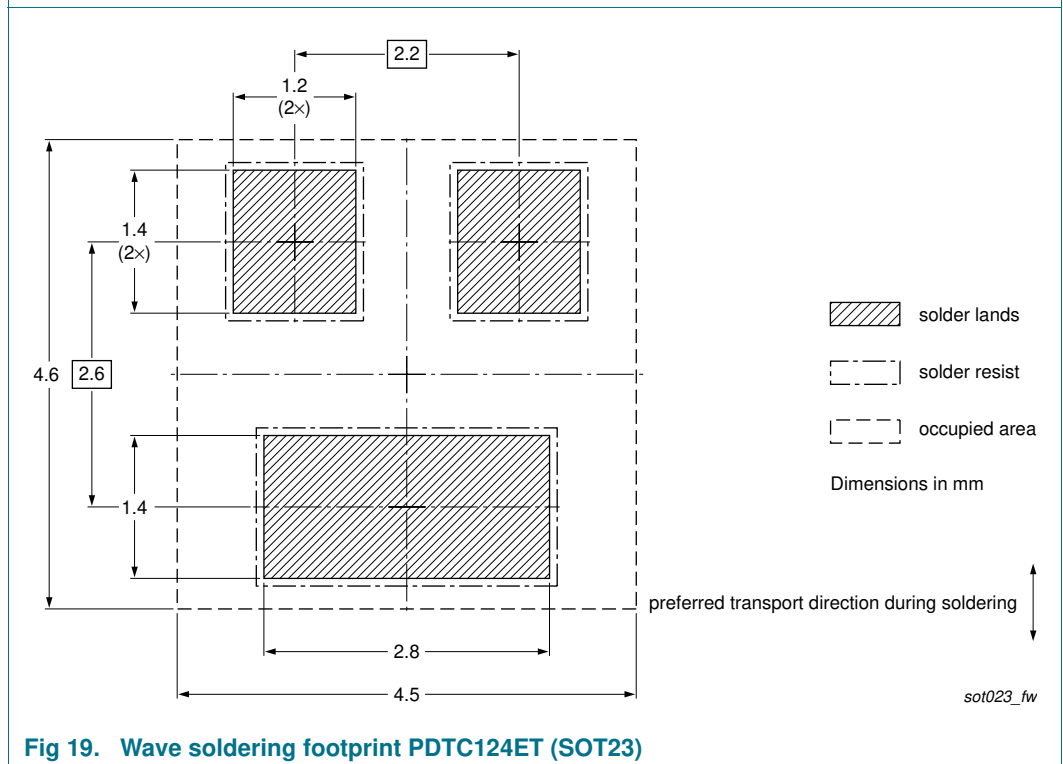


Fig 19. Wave soldering footprint PDTC124ET (SOT23)

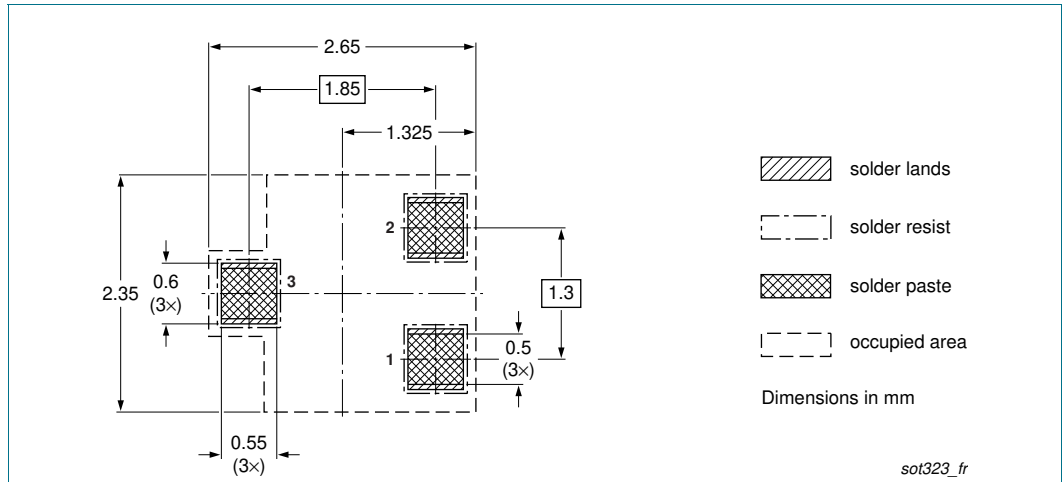


Fig 20. Reflow soldering footprint PDTC124EU (SOT323/SC-70)

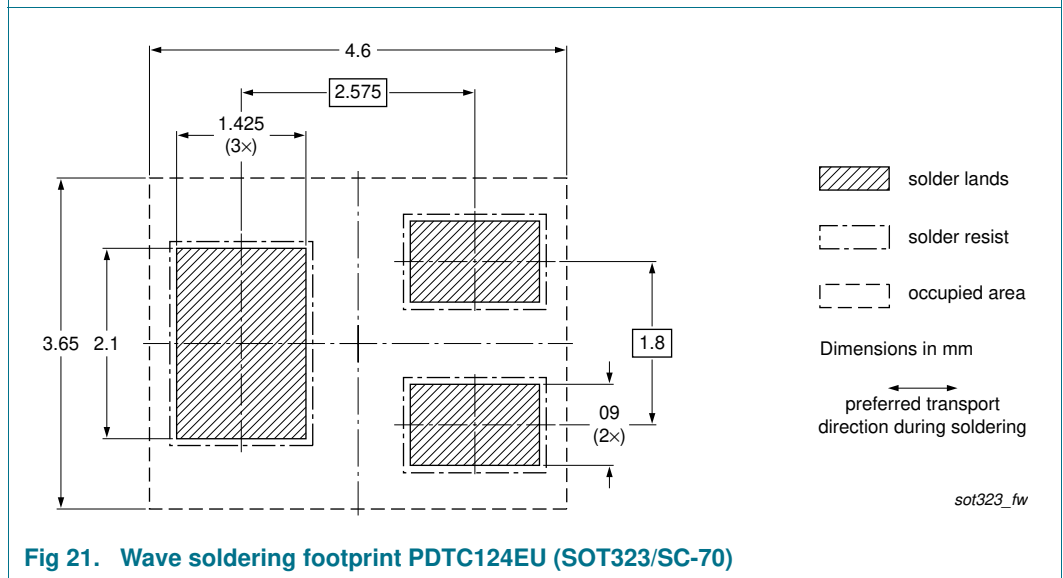


Fig 21. Wave soldering footprint PDTC124EU (SOT323/SC-70)

12. Revision history

Table 10. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---------------------|---|-----------------------|---------------|---------------------|
| PDTC124E_SER v.8 | 20111128 | Product data sheet | - | PDTC124E_SERIES v.7 |
| Modifications: | <ul style="list-style-type: none"> • The format of this document has been redesigned to comply with the new identity guidelines of NXP Semiconductors. • Legal texts have been adapted to the new company name where appropriate. • Type numbers PDTC124EEF, PDTC124EK and PDTC124ES removed. • Section 1 “Product profile”: updated • Section 3 “Ordering information”: added • Figure 1 to 11: added • Table 6 “Limiting values”: updated • Section 6 “Thermal characteristics”: updated • Table 8 “Characteristics”: $V_{i(on)}$ redefined to $V_{I(on)}$ on-state input voltage, $V_{i(off)}$ redefined to $V_{I(off)}$ off-state input voltage, I_{CEO} updated, f_T added • Section 8 “Test information”: added • Section 9 “Package outline”: superseded by minimized package outline drawings • Section 10 “Packing information”: added • Section 11 “Soldering”: added • Section 13 “Legal information”: updated | | | |
| PDTC124E_SERIES v.7 | 20040817 | Product data sheet | - | PDTC124E_SERIES v.6 |
| PDTC124E_SERIES v.6 | 20030414 | Product specification | - | - |

13. Legal information

13.1 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. |

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

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Date of release: 28 November 2011
Document identifier: PDTC124E_SER