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Kind regards,

Team Nexperia

# PDTD123E series

NPN 500 mA, 50 V resistor-equipped transistors;  
R1 = 2.2 k $\Omega$ , R2 = 2.2 k $\Omega$

Rev. 02 — 16 November 2009

Product data sheet

## 1. Product profile

### 1.1 General description

500 mA NPN Resistor-Equipped Transistors (RET) family.

Table 1. Product overview

| Type number              | Package |        |          | PNP complement |
|--------------------------|---------|--------|----------|----------------|
|                          | NXP     | JEITA  | JEDEC    |                |
| PDTD123EK                | SOT346  | SC-59A | TO-236   | PDTB123EK      |
| PDTD123ES <sup>[1]</sup> | SOT54   | SC-43A | TO-92    | PDTB123ES      |
| PDTD123ET                | SOT23   | -      | TO-236AB | PDTB123ET      |

[1] Also available in SOT54A and SOT54 variant packages (see [Section 2](#)).

### 1.2 Features

- Built-in bias resistors
- Simplifies circuit design
- 500 mA output current capability
- Reduces component count
- Reduces pick and place costs
- $\pm 10$  % resistor ratio tolerance

### 1.3 Applications

- Digital application in automotive and industrial segments
- Controlling IC inputs
- Cost saving alternative for BC817 series in digital applications
- Switching loads

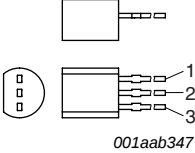
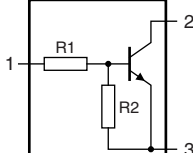
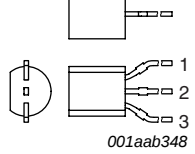
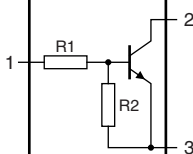
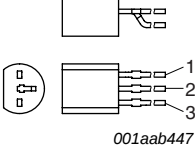
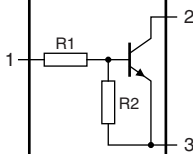
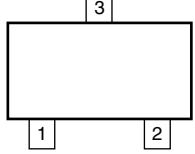
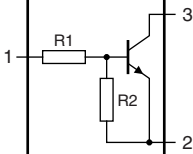
### 1.4 Quick reference data

Table 2. Quick reference data

| Symbol           | Parameter                 | Conditions | Min  | Typ | Max  | Unit       |
|------------------|---------------------------|------------|------|-----|------|------------|
| V <sub>CEO</sub> | collector-emitter voltage | open base  | -    | -   | 50   | V          |
| I <sub>O</sub>   | output current (DC)       |            | -    | -   | 500  | mA         |
| R1               | bias resistor 1 (input)   |            | 1.54 | 2.2 | 2.86 | k $\Omega$ |
| R2/R1            | bias resistor ratio       |            | 0.9  | 1.0 | 1.1  |            |

2. Pinning information

Table 3. Pinning

| Pin           | Description        | Simplified outline                                                                                 | Symbol                                                                                             |
|---------------|--------------------|----------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| SOT54         |                    |                                                                                                    |                                                                                                    |
| 1             | input (base)       | <br>001aab347   | <br>006aaa145   |
| 2             | output (collector) |                                                                                                    |                                                                                                    |
| 3             | GND (emitter)      |                                                                                                    |                                                                                                    |
| SOT54A        |                    |                                                                                                    |                                                                                                    |
| 1             | input (base)       | <br>001aab348   | <br>006aaa145   |
| 2             | output (collector) |                                                                                                    |                                                                                                    |
| 3             | GND (emitter)      |                                                                                                    |                                                                                                    |
| SOT54 variant |                    |                                                                                                    |                                                                                                    |
| 1             | input (base)       | <br>001aab447 | <br>006aaa145 |
| 2             | output (collector) |                                                                                                    |                                                                                                    |
| 3             | GND (emitter)      |                                                                                                    |                                                                                                    |
| SOT23, SOT346 |                    |                                                                                                    |                                                                                                    |
| 1             | input (base)       | <br>006aaa144 | <br>sym007    |
| 2             | GND (emitter)      |                                                                                                    |                                                                                                    |
| 3             | output (collector) |                                                                                                    |                                                                                                    |

### 3. Ordering information

Table 4. Ordering information

| Type number              | Package |                                                             |         |
|--------------------------|---------|-------------------------------------------------------------|---------|
|                          | Name    | Description                                                 | Version |
| PDTD123EK                | SC-59A  | plastic surface mounted package; 3 leads                    | SOT346  |
| PDTD123ES <sup>[1]</sup> | SC-43A  | plastic single-ended leaded (through hole) package; 3 leads | SOT54   |
| PDTD123ET                | -       | plastic surface mounted package; 3 leads                    | SOT23   |

[1] Also available in SOT54A and SOT54 variant packages (see [Section 2](#) and [Section 9](#)).

### 4. Marking

Table 5. Marking codes

| Type number | Marking code <sup>[1]</sup> |
|-------------|-----------------------------|
| PDTD123EK   | E3                          |
| PDTD123ES   | D123ES                      |
| PDTD123ET   | *7T                         |

[1] \* = -: made in Hong Kong  
 \* = p: made in Hong Kong  
 \* = t: made in Malaysia  
 \* = W: made in China

### 5. Limiting values

Table 6. Limiting values

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

| Symbol           | Parameter                 | Conditions               | Min            | Max  | Unit |
|------------------|---------------------------|--------------------------|----------------|------|------|
| V <sub>CBO</sub> | collector-base voltage    | open emitter             | -              | 50   | V    |
| V <sub>CEO</sub> | collector-emitter voltage | open base                | -              | 50   | V    |
| V <sub>EBO</sub> | emitter-base voltage      | open collector           | -              | 10   | V    |
| V <sub>I</sub>   | input voltage             |                          |                |      |      |
|                  | positive                  |                          | -              | +12  | V    |
|                  | negative                  |                          | -              | -10  | V    |
| I <sub>O</sub>   | output current (DC)       |                          | -              | 500  | mA   |
| P <sub>tot</sub> | total power dissipation   | T <sub>amb</sub> ≤ 25 °C | <sup>[1]</sup> |      |      |
|                  | SOT346                    |                          | -              | 250  | mW   |
|                  | SOT54                     |                          | -              | 500  | mW   |
|                  | SOT23                     |                          | -              | 250  | mW   |
| T <sub>stg</sub> | storage temperature       |                          | -65            | +150 | °C   |
| T <sub>j</sub>   | junction temperature      |                          | -              | 150  | °C   |
| T <sub>amb</sub> | ambient temperature       |                          | -65            | +150 | °C   |

[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and 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 | [1] |     |     |      |
|               | SOT346                                      |             | -   | -   | 500 | K/W  |
|               | SOT54                                       |             | -   | -   | 250 | K/W  |
|               | SOT23                                       |             | -   | -   | 500 | K/W  |

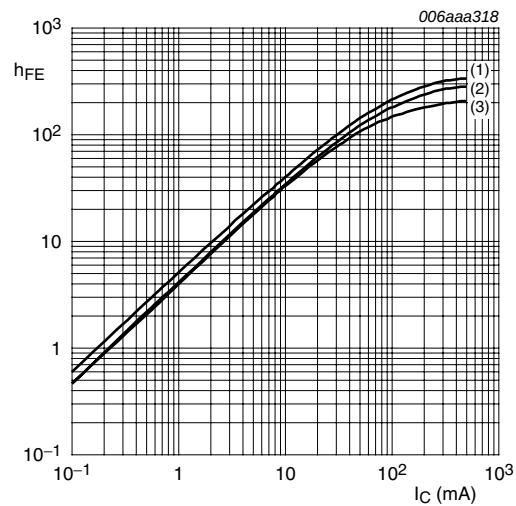
[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.

## 7. Characteristics

**Table 8. Characteristics**

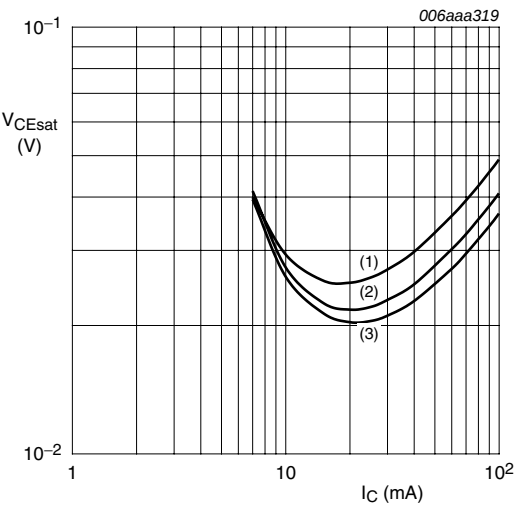
$T_{amb} = 25\text{ }^{\circ}\text{C}$  unless otherwise specified.

| Symbol       | Parameter                            | Conditions                                                              | Min  | Typ | Max  | Unit          |
|--------------|--------------------------------------|-------------------------------------------------------------------------|------|-----|------|---------------|
| $I_{CBO}$    | collector-base cut-off current       | $V_{CB} = 40\text{ V}; I_E = 0\text{ A}$                                | -    | -   | 100  | nA            |
|              |                                      | $V_{CB} = 50\text{ V}; I_E = 0\text{ A}$                                | -    | -   | 100  | nA            |
| $I_{CEO}$    | collector-emitter cut-off current    | $V_{CE} = 50\text{ V}; I_B = 0\text{ A}$                                | -    | -   | 0.5  | $\mu\text{A}$ |
| $I_{EBO}$    | emitter-base cut-off current         | $V_{EB} = 5\text{ V}; I_C = 0\text{ A}$                                 | -    | -   | 2    | mA            |
| $h_{FE}$     | DC current gain                      | $V_{CE} = 5\text{ V}; I_C = 50\text{ mA}$                               | 40   | -   | -    |               |
| $V_{CEsat}$  | collector-emitter saturation voltage | $I_C = 50\text{ mA}; I_B = 2.5\text{ mA}$                               | -    | -   | 0.3  | V             |
| $V_{I(off)}$ | off-state input voltage              | $V_{CE} = 5\text{ V}; I_C = 100\text{ }\mu\text{A}$                     | 0.6  | 1.1 | 1.8  | V             |
| $V_{I(on)}$  | on-state input voltage               | $V_{CE} = 0.3\text{ V}; I_C = 20\text{ mA}$                             | 1.0  | 1.5 | 2.0  | V             |
| R1           | bias resistor 1 (input)              |                                                                         | 1.54 | 2.2 | 2.86 | k $\Omega$    |
| R2/R1        | bias resistor ratio                  |                                                                         | 0.9  | 1.0 | 1.1  |               |
| $C_c$        | collector capacitance                | $V_{CB} = 10\text{ V}; I_E = i_e = 0\text{ A};$<br>$f = 100\text{ MHz}$ | -    | 7   | -    | pF            |



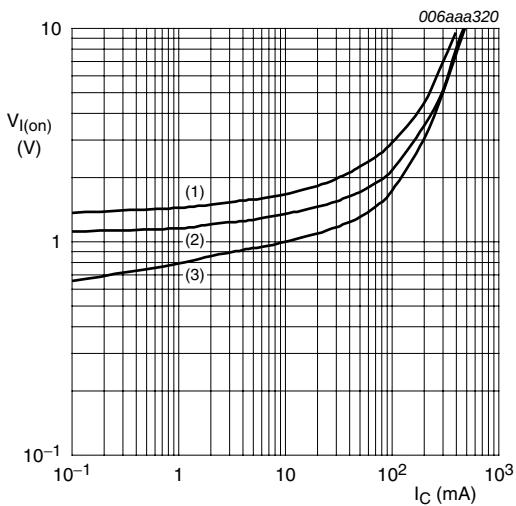
- $V_{CE} = 5\text{ V}$
- (1)  $T_{amb} = 100^\circ\text{C}$
  - (2)  $T_{amb} = 25^\circ\text{C}$
  - (3)  $T_{amb} = -40^\circ\text{C}$

Fig 1. DC current gain as a function of collector current; typical values



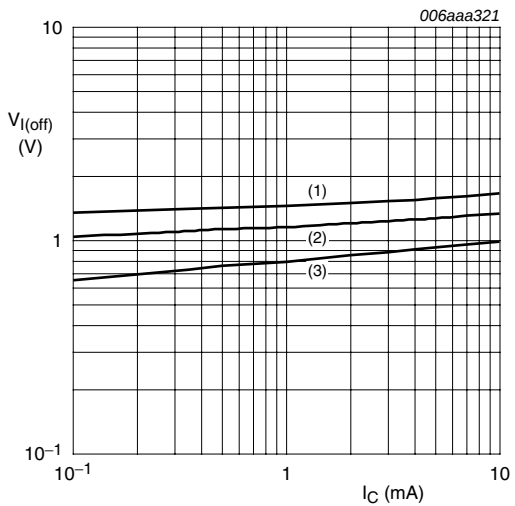
- $I_C/I_B = 20$
- (1)  $T_{amb} = 100^\circ\text{C}$
  - (2)  $T_{amb} = 25^\circ\text{C}$
  - (3)  $T_{amb} = -40^\circ\text{C}$

Fig 2. Collector-emitter saturation voltage as a function of collector current; typical values



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

Fig 3. On-state input voltage as a function of collector current; typical values



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

Fig 4. Off-state input voltage as a function of collector current; typical values

## 8. Package outline

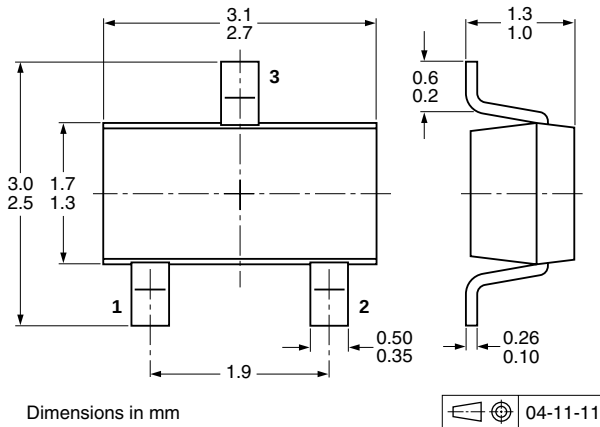


Fig 5. Package outline SOT346 (SC-59A/TO-236)

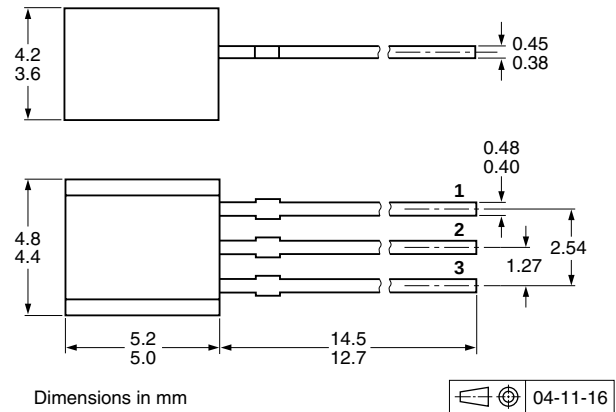


Fig 6. Package outline SOT54 (SC-43A/TO-92)

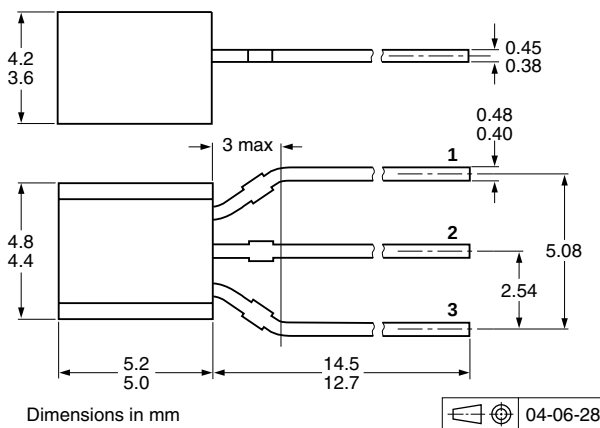


Fig 7. Package outline SOT54A

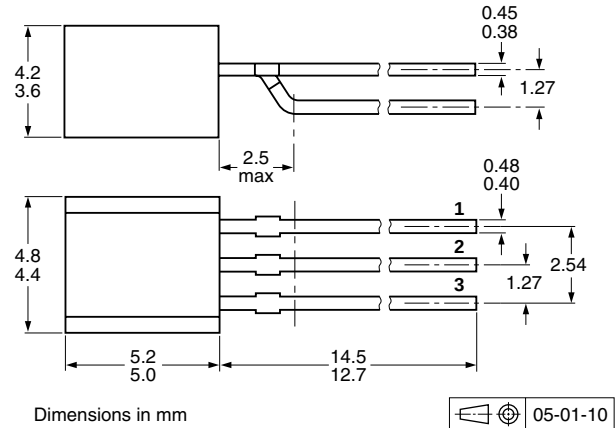


Fig 8. Package outline SOT54 variant

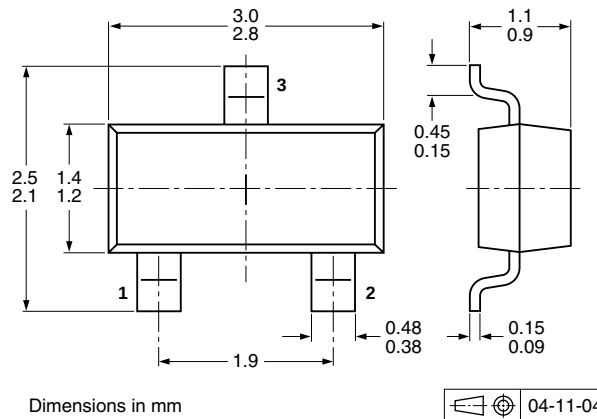


Fig 9. Package outline SOT23 (TO-236AB)

## 9. 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 |
| PDTD123EK   | SOT346        | 4 mm pitch, 8 mm tape and reel | -115             | -    | -135  |
| PDTD123ES   | SOT54         | bulk, straight leads           | -                | -412 | -     |
|             | SOT54A        | tape and reel, wide pitch      | -                | -    | -116  |
|             |               | tape ammopack, wide pitch      | -                | -    | -126  |
|             | SOT54 variant | bulk, delta pinning            | -                | -112 | -     |
| PDTD123ET   | SOT23         | 4 mm pitch, 8 mm tape and reel | -215             | -    | -235  |

[1] For further information and the availability of packing methods, see [Section 12](#).

## 10. Revision history

**Table 10.** Revision history

| Document ID    | Release date                                                                                                                                                                                                                    | Data sheet status  | Change notice | Supersedes     |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|---------------|----------------|
| PDTD123E_SER_2 | 20091116                                                                                                                                                                                                                        | Product data sheet | -             | PDTD123E_SER_1 |
| Modifications: | <ul style="list-style-type: none"><li>This data sheet was changed to reflect the new company name NXP Semiconductors, including new legal definitions and disclaimers. No changes were made to the technical content.</li></ul> |                    |               |                |
| PDTD123E_SER_1 | 20050408                                                                                                                                                                                                                        | Product data sheet | -             | -              |

## 11. Legal information

### 11.1 Data sheet status

| Document status <sup>[1][2]</sup> | Product status <sup>[3]</sup> | 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".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <http://www.nxp.com>.

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13. Contents

1 Product profile ..... 1

1.1 General description ..... 1

1.2 Features ..... 1

1.3 Applications ..... 1

1.4 Quick reference data ..... 1

2 Pinning information..... 2

3 Ordering information..... 3

4 Marking ..... 3

5 Limiting values..... 3

6 Thermal characteristics ..... 4

7 Characteristics..... 4

8 Package outline ..... 6

9 Packing information ..... 7

10 Revision history..... 8

11 Legal information..... 9

11.1 Data sheet status ..... 9

11.2 Definitions..... 9

11.3 Disclaimers..... 9

11.4 Trademarks..... 9

12 Contact information..... 9

13 Contents ..... 10



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