

# BC635; BCP54; BCX54

45 V, 1 A NPN medium power transistors

Rev. 07 — 4 June 2007

Product data sheet

## 1. Product profile

### 1.1 General description

NPN medium power transistor series.

Table 1. Product overview

| Type number <sup>[1]</sup> | Package |        |        | PNP complement |
|----------------------------|---------|--------|--------|----------------|
|                            | NXP     | JEITA  | JEDEC  |                |
| BC635 <sup>[2]</sup>       | SOT54   | SC-43A | TO-92  | BC636          |
| BCP54                      | SOT223  | SC-73  | -      | BCP51          |
| BCX54                      | SOT89   | SC-62  | TO-243 | BCX51          |

[1] Valid for all available selection groups.

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

### 1.2 Features

- High current
- Two current gain selections
- High power dissipation capability

### 1.3 Applications

- Linear voltage regulators
- Low side switches
- MOSFET drivers
- Amplifiers

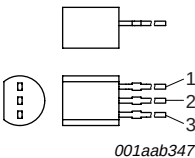
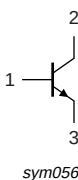
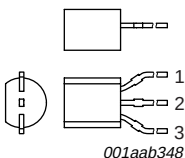
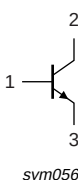
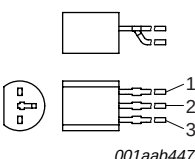
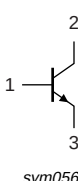
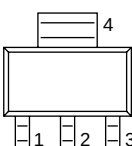
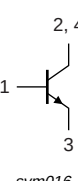
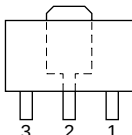
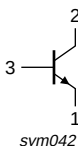
### 1.4 Quick reference data

Table 2. Quick reference data

| Symbol    | Parameter                 | Conditions                     | Min | Typ | Max | Unit |
|-----------|---------------------------|--------------------------------|-----|-----|-----|------|
| $V_{CEO}$ | collector-emitter voltage | open base                      | -   | -   | 45  | V    |
| $I_C$     | collector current         |                                | -   | -   | 1   | A    |
| $I_{CM}$  | peak collector current    | single pulse; $t_p \leq 1$ ms  | -   | -   | 1.5 | A    |
| $h_{FE}$  | DC current gain           | $V_{CE} = 2$ V; $I_C = 150$ mA | 63  | -   | 250 |      |
|           | $h_{FE}$ selection -10    | $V_{CE} = 2$ V; $I_C = 150$ mA | 63  | -   | 160 |      |
|           | $h_{FE}$ selection -16    | $V_{CE} = 2$ V; $I_C = 150$ mA | 100 | -   | 250 |      |

2. Pinning information

Table 3. Pinning

| Pin           | Description | Simplified outline                                                                    | Symbol                                                                                |
|---------------|-------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| SOT54         |             |                                                                                       |                                                                                       |
| 1             | base        |    |    |
| 2             | collector   |                                                                                       |                                                                                       |
| 3             | emitter     |                                                                                       |                                                                                       |
| SOT54A        |             |                                                                                       |                                                                                       |
| 1             | base        |    |    |
| 2             | collector   |                                                                                       |                                                                                       |
| 3             | emitter     |                                                                                       |                                                                                       |
| SOT54 variant |             |                                                                                       |                                                                                       |
| 1             | base        |  |  |
| 2             | collector   |                                                                                       |                                                                                       |
| 3             | emitter     |                                                                                       |                                                                                       |
| SOT223        |             |                                                                                       |                                                                                       |
| 1             | base        |  |  |
| 2             | collector   |                                                                                       |                                                                                       |
| 3             | emitter     |                                                                                       |                                                                                       |
| 4             | collector   |                                                                                       |                                                                                       |
| SOT89         |             |                                                                                       |                                                                                       |
| 1             | emitter     |  |  |
| 2             | collector   |                                                                                       |                                                                                       |
| 3             | base        |                                                                                       |                                                                                       |

### 3. Ordering information

**Table 4. Ordering information**

| Type number <sup>[1]</sup> | Package |                                                                                |         |
|----------------------------|---------|--------------------------------------------------------------------------------|---------|
|                            | Name    | Description                                                                    | Version |
| BC635 <sup>[2]</sup>       | SC-43A  | plastic single-ended leaded (through hole) package; 3 leads                    | SOT54   |
| BCP54                      | SC-73   | plastic surface-mounted package with increased heatsink; 4 leads               | SOT223  |
| BCX54                      | SC-62   | plastic surface-mounted package; collector pad for good heat transfer; 3 leads | SOT89   |

[1] Valid for all available selection groups.

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

### 4. Marking

**Table 5. Marking codes**

| Type number | Marking code |
|-------------|--------------|
| BC635       | C635         |
| BC635-16    | C63516       |
| BCP54       | BCP54        |
| BCP54-10    | BCP54/10     |
| BCP54-16    | BCP54/16     |
| BCX54       | BA           |
| BCX54-10    | BC           |
| BCX54-16    | BD           |

## 5. Limiting values

**Table 6. Limiting values**

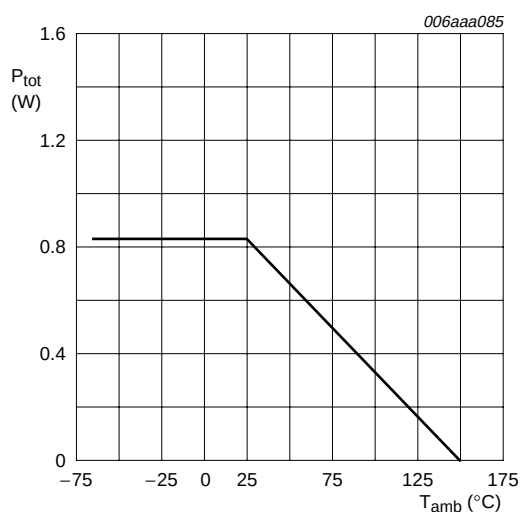
*In accordance with the Absolute Maximum Rating System (IEC 60134).*

| Symbol    | Parameter                 | Conditions                       | Min   | Max  | Unit |
|-----------|---------------------------|----------------------------------|-------|------|------|
| $V_{CBO}$ | collector-base voltage    | open emitter                     | -     | 45   | V    |
| $V_{CEO}$ | collector-emitter voltage | open base                        | -     | 45   | V    |
| $V_{EBO}$ | emitter-base voltage      | open collector                   | -     | 5    | V    |
| $I_C$     | collector current         |                                  | -     | 1    | A    |
| $I_{CM}$  | peak collector current    | single pulse;<br>$t_p \leq 1$ ms | -     | 1.5  | A    |
| $I_{BM}$  | peak base current         | single pulse;<br>$t_p \leq 1$ ms | -     | 0.2  | A    |
| $P_{tot}$ | total power dissipation   | $T_{amb} \leq 25$ °C             |       |      |      |
|           | BC635                     |                                  | [1] - | 0.83 | W    |
|           | BCP54                     |                                  | [1] - | 0.64 | W    |
|           |                           |                                  | [2] - | 0.96 | W    |
|           | BCX54                     |                                  | [1] - | 0.5  | W    |
|           |                           |                                  | [2] - | 0.85 | W    |
|           |                           |                                  | [3] - | 1.25 | W    |
| $T_j$     | 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.

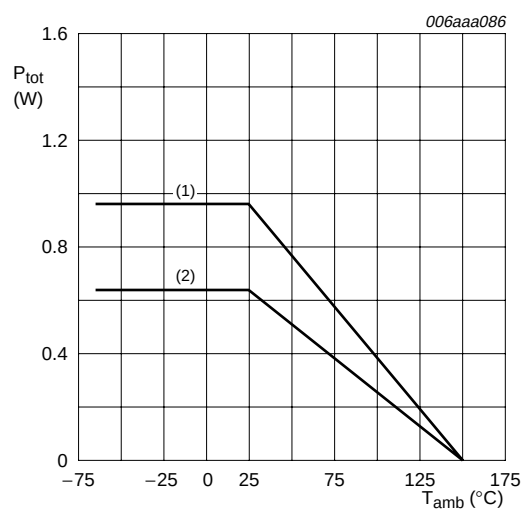
[2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 1 cm<sup>2</sup>.

[3] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 6 cm<sup>2</sup>.



FR4 PCB, standard footprint

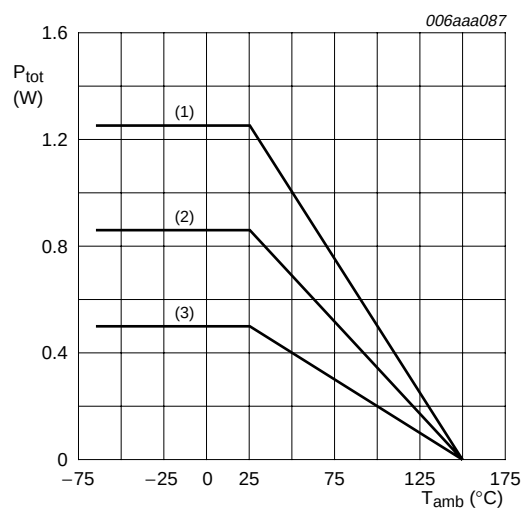
**Fig 1. Power derating curve SOT54**



(1) FR4 PCB, mounting pad for collector 1 cm<sup>2</sup>

(2) FR4 PCB, standard footprint

**Fig 2. Power derating curves SOT223**



(1) FR4 PCB, mounting pad for collector 6 cm<sup>2</sup>

(2) FR4 PCB, mounting pad for collector 1 cm<sup>2</sup>

(3) FR4 PCB, standard footprint

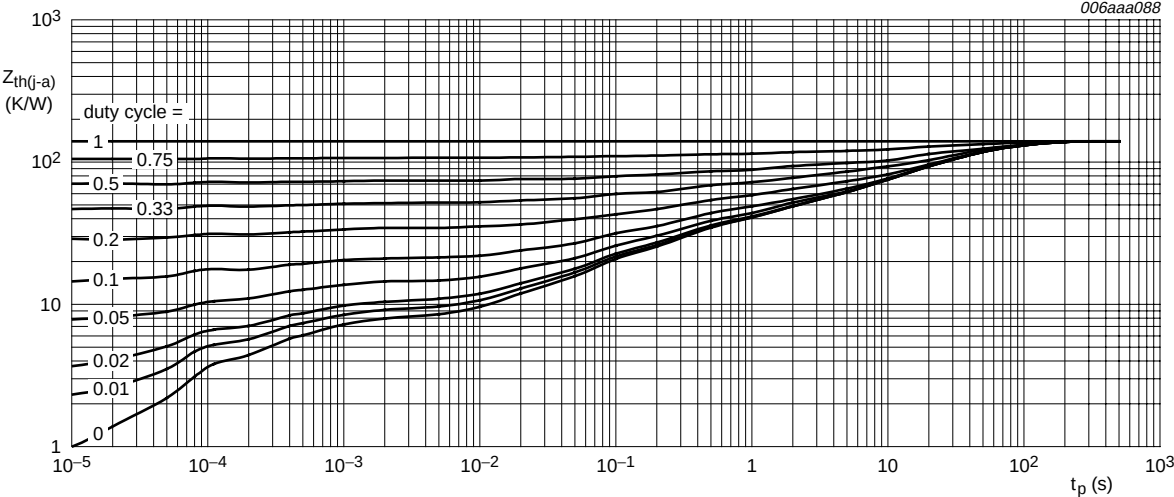
**Fig 3. Power derating curves SOT89**

6. Thermal characteristics

Table 7. Thermal characteristics

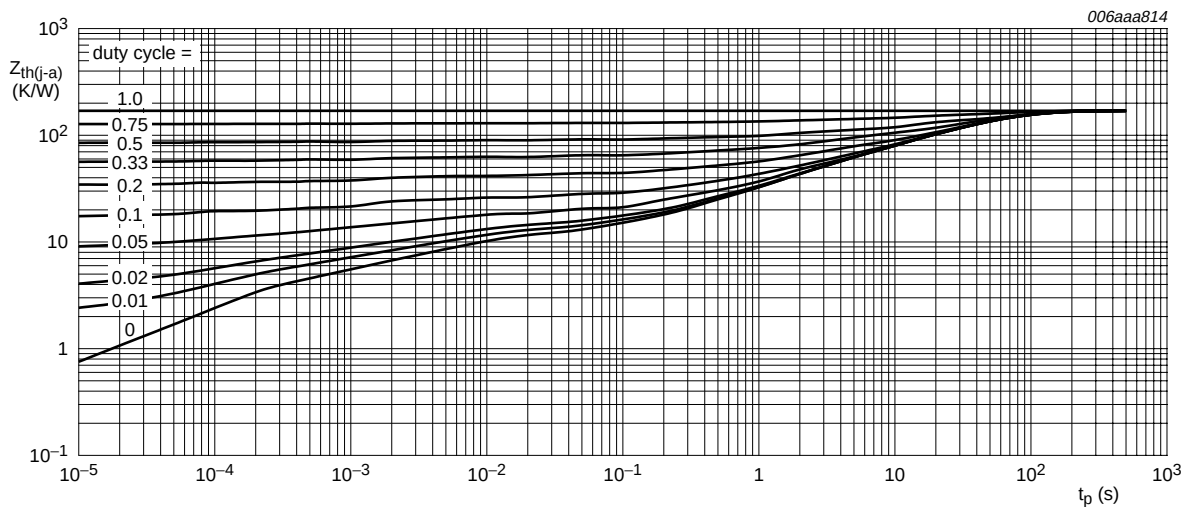
| Symbol         | Parameter                                        | Conditions  | Min | Typ | Max | Unit |
|----------------|--------------------------------------------------|-------------|-----|-----|-----|------|
| $R_{th(j-a)}$  | thermal resistance from junction to ambient      | in free air |     |     |     |      |
|                | BC635                                            | [1]         | -   | -   | 150 | K/W  |
|                | BCP54                                            | [1]         | -   | -   | 195 | K/W  |
|                |                                                  | [2]         | -   | -   | 130 | K/W  |
|                | BCX54                                            | [1]         | -   | -   | 250 | K/W  |
|                |                                                  | [2]         | -   | -   | 145 | K/W  |
|                |                                                  | [3]         | -   | -   | 100 | K/W  |
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point |             |     |     |     |      |
|                | BC635                                            |             | -   | -   | 40  | K/W  |
|                | BCP54                                            |             | -   | -   | 17  | K/W  |
|                | BCX54                                            |             | -   | -   | 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 1 cm<sup>2</sup>.  
[3] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 6 cm<sup>2</sup>.



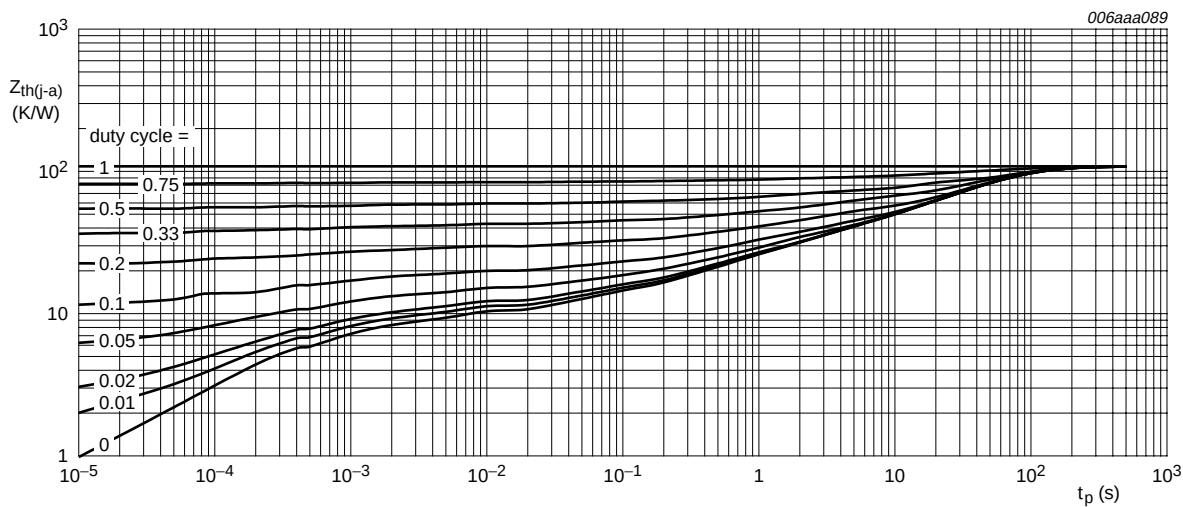
FR4 PCB, standard footprint

Fig 4. Transient thermal impedance from junction to ambient as a function of pulse duration for SOT54; typical values



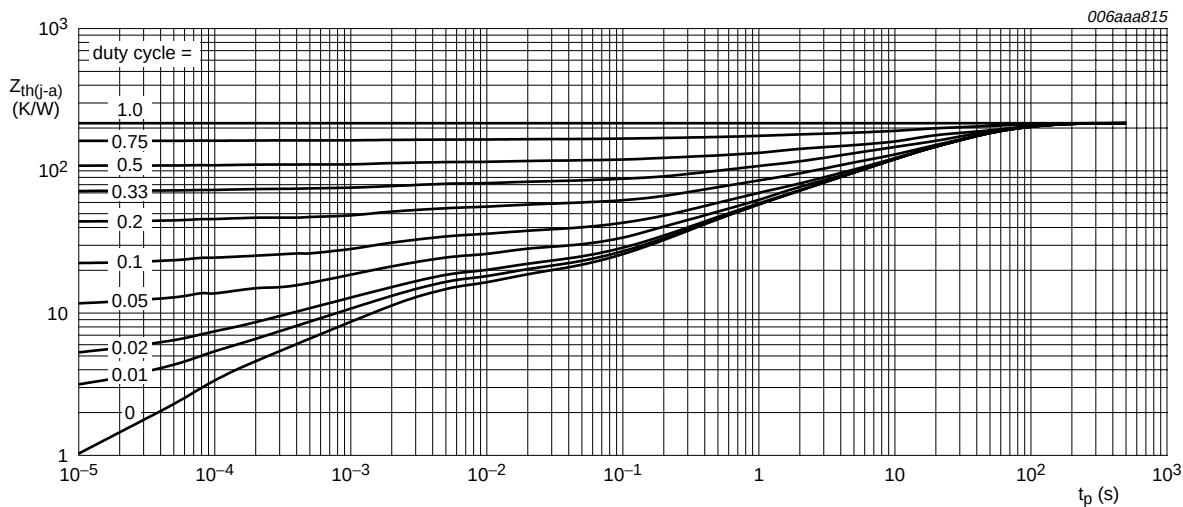
FR4 PCB, standard footprint

Fig 5. Transient thermal impedance from junction to ambient as a function of pulse duration for SOT223; typical values



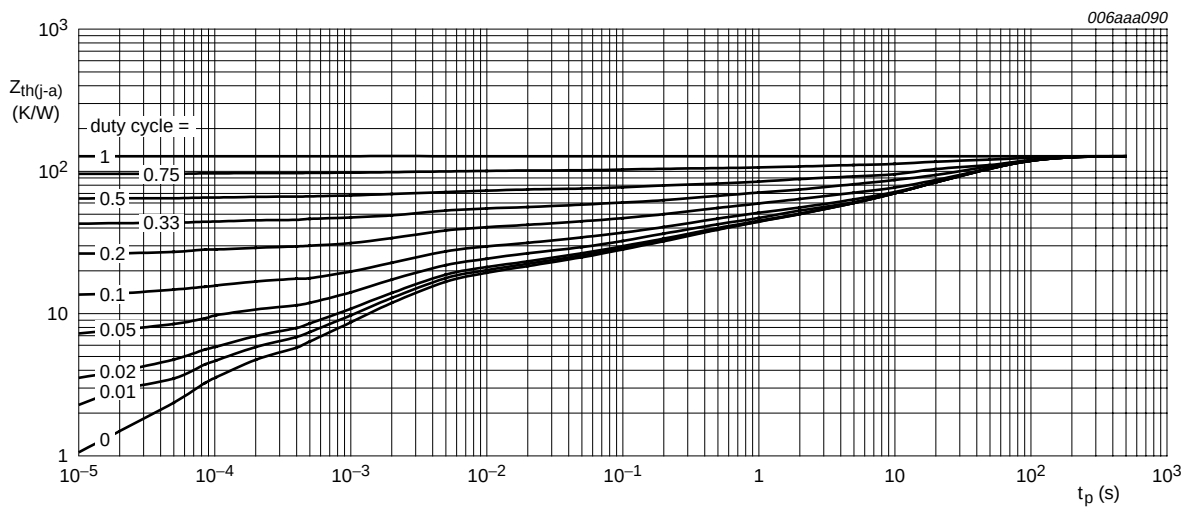
FR4 PCB, mounting pad for collector 1 cm<sup>2</sup>

Fig 6. Transient thermal impedance from junction to ambient as a function of pulse duration for SOT223; typical values



FR4 PCB, standard footprint

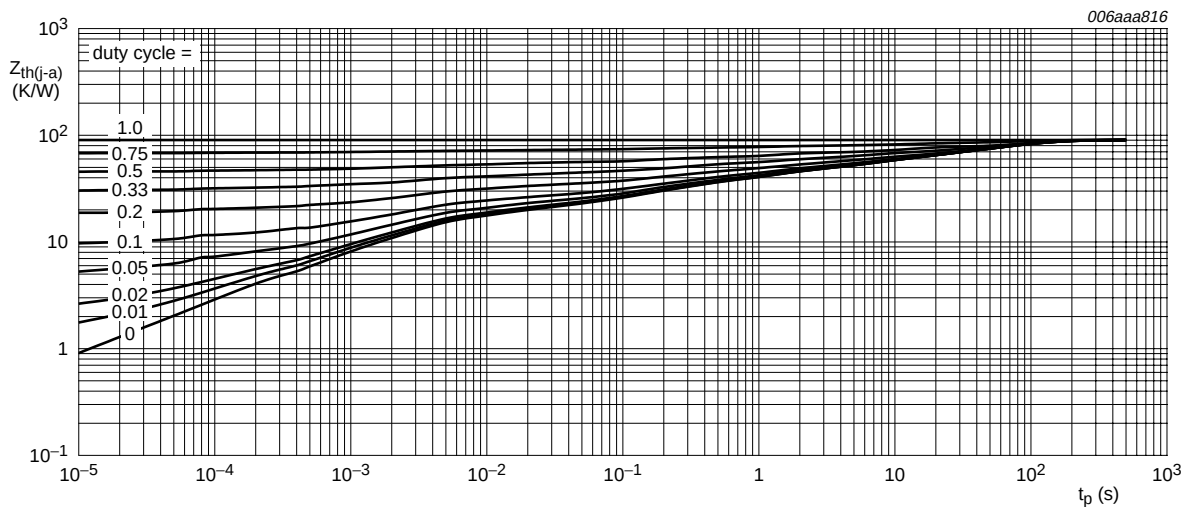
Fig 7. Transient thermal impedance from junction to ambient as a function of pulse duration for SOT89; typical values



FR4 PCB, mounting pad for collector 1 cm<sup>2</sup>

Fig 8. Transient thermal impedance from junction to ambient as a function of pulse duration for SOT89; typical values





FR4 PCB, mounting pad for collector 6 cm<sup>2</sup>

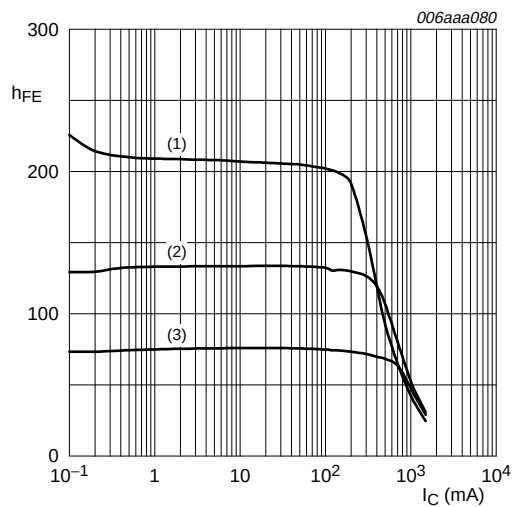
Fig 9. Transient thermal impedance from junction to ambient as a function of pulse duration for SOT89; typical values

7. Characteristics

Table 8. Characteristics  
*T<sub>amb</sub> = 25 °C unless otherwise specified.*

| Symbol             | Parameter                            | Conditions                                                               | Min    | Typ | Max | Unit |
|--------------------|--------------------------------------|--------------------------------------------------------------------------|--------|-----|-----|------|
| I <sub>CBO</sub>   | collector-base cut-off current       | V <sub>CB</sub> = 30 V; I <sub>E</sub> = 0 A                             | -      | -   | 100 | nA   |
|                    |                                      | V <sub>CB</sub> = 30 V; I <sub>E</sub> = 0 A; T <sub>j</sub> = 150 °C    | -      | -   | 10  | μA   |
| I <sub>EBO</sub>   | emitter-base cut-off current         | V <sub>EB</sub> = 5 V; I <sub>C</sub> = 0 A                              | -      | -   | 100 | nA   |
| h <sub>FE</sub>    | DC current gain                      | V <sub>CE</sub> = 2 V                                                    |        |     |     |      |
|                    |                                      | I <sub>C</sub> = 5 mA                                                    | 63     | -   | -   |      |
|                    |                                      | I <sub>C</sub> = 150 mA                                                  | 63     | -   | 250 |      |
|                    |                                      | I <sub>C</sub> = 500 mA                                                  | [1] 40 | -   | -   |      |
|                    | DC current gain                      | V <sub>CE</sub> = 2 V                                                    |        |     |     |      |
|                    |                                      |                                                                          |        |     |     |      |
|                    | h <sub>FE</sub> selection -10        | I <sub>C</sub> = 150 mA                                                  | 63     | -   | 160 |      |
|                    | h <sub>FE</sub> selection -16        | I <sub>C</sub> = 150 mA                                                  | 100    | -   | 250 |      |
| V <sub>CEsat</sub> | collector-emitter saturation voltage | I <sub>C</sub> = 500 mA; I <sub>B</sub> = 50 mA                          | [1] -  | -   | 500 | mV   |
| V <sub>BE</sub>    | base-emitter voltage                 | V <sub>CE</sub> = 2 V; I <sub>C</sub> = 500 mA                           | [1] -  | -   | 1   | V    |
| C <sub>c</sub>     | collector capacitance                | V <sub>CB</sub> = 10 V; I <sub>E</sub> = i <sub>e</sub> = 0 A; f = 1 MHz | -      | 6   | -   | pF   |
| f <sub>T</sub>     | transition frequency                 | V <sub>CE</sub> = 5 V; I <sub>C</sub> = 50 mA; f = 100 MHz               | 100    | 180 | -   | MHz  |

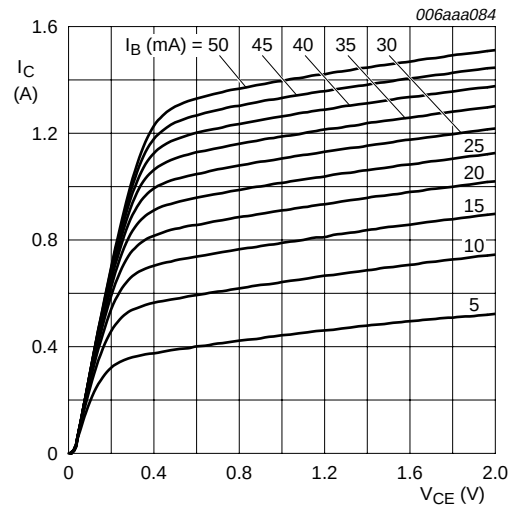
[1] Pulse test: t<sub>p</sub> ≤ 300 μs; δ = 0.02.



V<sub>CE</sub> = 2 V

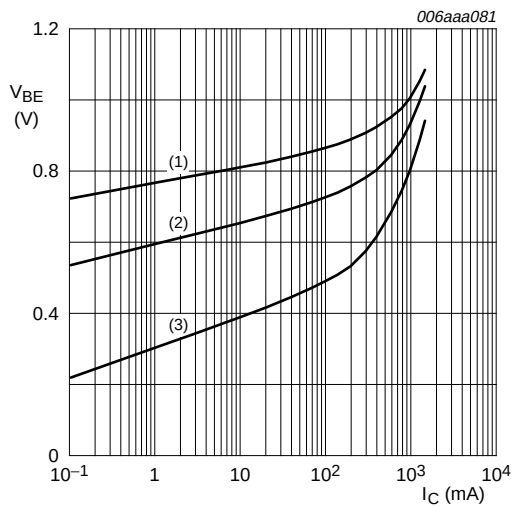
- (1) T<sub>amb</sub> = 150 °C
- (2) T<sub>amb</sub> = 25 °C
- (3) T<sub>amb</sub> = -55 °C

Fig 10. DC current gain as a function of collector current; typical values



T<sub>amb</sub> = 25 °C

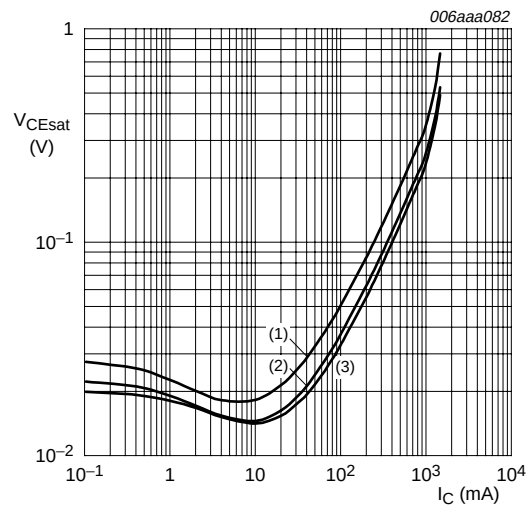
Fig 11. Collector current as a function of collector-emitter voltage; typical values



V<sub>CE</sub> = 2 V

- (1) T<sub>amb</sub> = -55 °C
- (2) T<sub>amb</sub> = 25 °C
- (3) T<sub>amb</sub> = 150 °C

Fig 12. Base-emitter voltage as a function of collector current; typical values

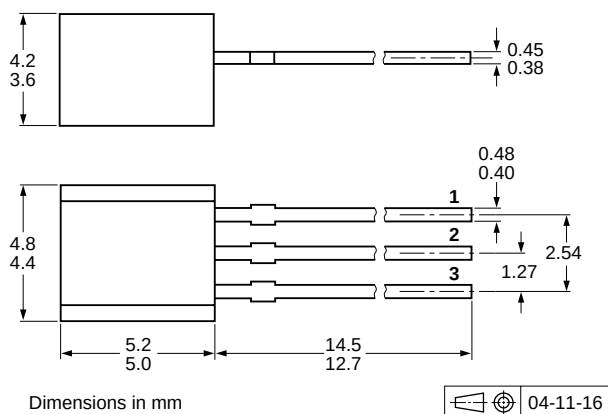
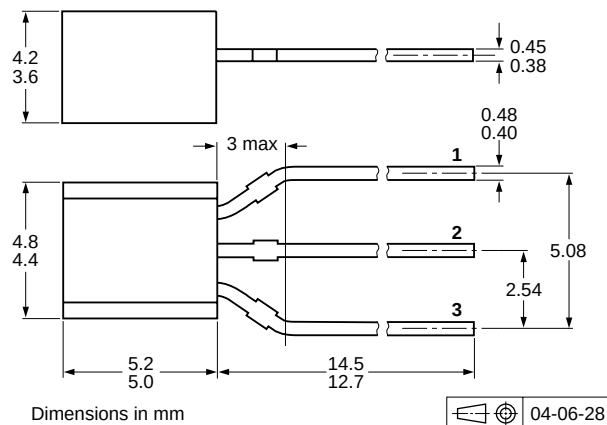
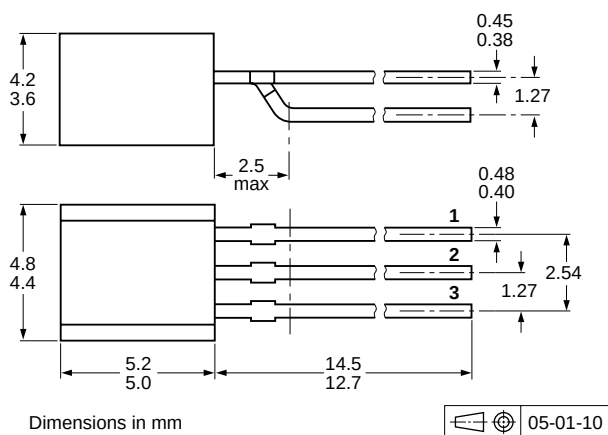
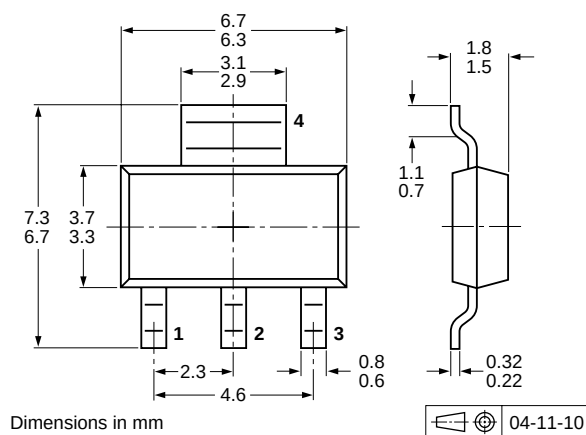
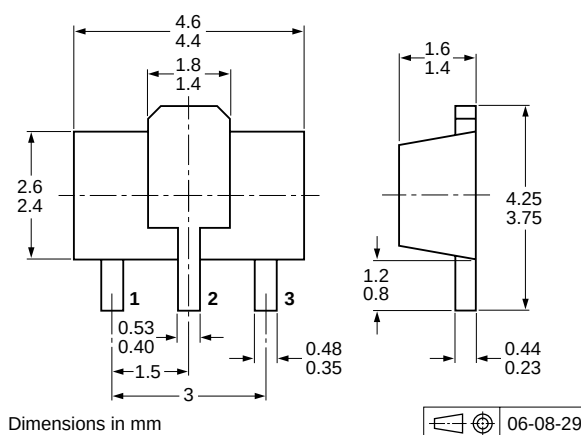


I<sub>C</sub>/I<sub>B</sub> = 10

- (1) T<sub>amb</sub> = 150 °C
- (2) T<sub>amb</sub> = 25 °C
- (3) T<sub>amb</sub> = -55 °C

Fig 13. Collector-emitter saturation voltage as a function of collector current; typical values

## 8. Package outline

**Fig 14. Package outline SOT54 (SC-43A/TO-92)****Fig 15. Package outline SOT54A****Fig 16. Package outline SOT54 variant****Fig 17. Package outline SOT223 (SC-73)****Fig 18. Package outline SOT89 (SC-62/TO-243)**

## 9. Packing information

**Table 9. Packing methods**

The indicated -xxx are the last three digits of the 12NC ordering code.<sup>[1]</sup>

| Type number <sup>[2]</sup> | Package       | Description                                        | Packing quantity |      |      |       |
|----------------------------|---------------|----------------------------------------------------|------------------|------|------|-------|
|                            |               |                                                    | 1000             | 4000 | 5000 | 10000 |
| BC635                      | SOT54         | bulk, straight leads                               | -                | -    | -412 | -     |
|                            | SOT54A        | tape and reel, wide pitch                          | -                | -    | -    | -116  |
|                            |               | tape ammopack, wide pitch                          | -                | -    | -    | -126  |
|                            | SOT54 variant | bulk, delta pinning                                | -                | -    | -112 | -     |
| BCP54                      | SOT223        | 8 mm pitch, 12 mm tape and reel                    | -115             | -135 | -    | -     |
| BCX54                      | SOT89         | 8 mm pitch, 12 mm tape and reel; T1 <sup>[3]</sup> | -115             | -135 | -    | -     |
|                            |               | 8 mm pitch, 12 mm tape and reel; T3 <sup>[4]</sup> | -120             | -    | -    | -     |

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

[2] Valid for all available selection groups.

[3] T1: normal taping

[4] T3: 90° rotated taping

## 10. Revision history

Table 10. Revision history

| Document ID                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Release date | Data sheet status     | Change notice | Supersedes                                        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-----------------------|---------------|---------------------------------------------------|
| BC635_BCP54_BCX54_7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 20070604     | Product data sheet    | -             | BC635_BCP54_BCX54_6                               |
| Modifications: <ul style="list-style-type: none"> <li>• <a href="#">Table 1 "Product overview"</a>: amended</li> <li>• <a href="#">Section 1.2 "Features"</a>: amended</li> <li>• <a href="#">Section 1.3 "Applications"</a>: amended</li> <li>• <a href="#">Table 2 "Quick reference data"</a>: <math>I_C</math> parameter redefined to collector current</li> <li>• <a href="#">Table 2 "Quick reference data"</a>: <math>I_{CM}</math> condition added</li> <li>• <a href="#">Figure 2</a> and <a href="#">3</a>: amended</li> <li>• <a href="#">Table 6 "Limiting values"</a>: <math>I_C</math> parameter redefined to collector current</li> <li>• <a href="#">Table 6 "Limiting values"</a>: <math>I_{CM}</math> condition added</li> <li>• <a href="#">Table 6 "Limiting values"</a>: <math>P_{tot}</math> values for BCP54 and BCX54 adapted</li> <li>• <a href="#">Table 7 "Thermal characteristics"</a>: <math>R_{th(j-a)}</math> values for BCP54 and BCX54 rounded</li> <li>• <a href="#">Figure 4</a>: <math>Z_{th}</math> redefined to <math>Z_{th(j-a)}</math> transient thermal impedance from junction to ambient</li> <li>• <a href="#">Figure 4</a>: <math>t_p</math> parameter redefined to pulse duration</li> <li>• <a href="#">Figure 5</a>: added</li> <li>• <a href="#">Figure 6</a>: <math>Z_{th}</math> redefined to <math>Z_{th(j-a)}</math> transient thermal impedance from junction to ambient</li> <li>• <a href="#">Figure 6</a>: <math>t_p</math> parameter redefined to pulse duration</li> <li>• <a href="#">Figure 7</a>: added</li> <li>• <a href="#">Figure 8</a>: <math>Z_{th}</math> redefined to <math>Z_{th(j-a)}</math> transient thermal impedance from junction to ambient</li> <li>• <a href="#">Figure 8</a>: <math>t_p</math> parameter redefined to pulse duration</li> <li>• <a href="#">Figure 9</a>: added</li> <li>• <a href="#">Figure 11</a>: amended</li> <li>• <a href="#">Table 9 "Packing methods"</a>: new packing method for BCX54 added</li> <li>• <a href="#">Section 11 "Legal information"</a>: updated</li> </ul> |              |                       |               |                                                   |
| BC635_BCP54_BCX54_6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 20050225     | Product data sheet    | CPCN200405029 | BC635_637_639_4<br>BCP54_55_56_5<br>BCX54_55_56_4 |
| BC635_637_639_4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 20011010     | Product specification | -             | BC635_637_639_3                                   |
| BCP54_55_56_5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 20030206     | Product specification | -             | BCP54_55_56_4                                     |
| BCX54_55_56_4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 20011010     | Product specification | -             | BCX54_55_56_3                                     |

## 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".

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