

# BCP56; BCX56; BC56PA

80 V, 1 A NPN medium power transistors

Rev. 9 — 25 October 2011

Product data sheet

## 1. Product profile

### 1.1 General description

NPN medium power transistor series in Surface-Mounted Device (SMD) plastic packages.

Table 1. Product overview

| Type number <sup>[1]</sup> | Package  |       |        | PNP complement |
|----------------------------|----------|-------|--------|----------------|
|                            | Nexperia | JEITA | JEDEC  |                |
| BCP56                      | SOT223   | SC-73 | -      | BCP53          |
| BCX56                      | SOT89    | SC-62 | TO-243 | BCX53          |
| BC56PA                     | SOT1061  | -     | -      | BC53PA         |

[1] Valid for all available selection groups.

### 1.2 Features and benefits

- High current
- Three current gain selections
- High power dissipation capability
- Exposed heatsink for excellent thermal and electrical conductivity (SOT89, SOT1061)
- Leadless very small SMD plastic package with medium power capability (SOT1061)
- AEC-Q101 qualified

### 1.3 Applications

- Linear voltage regulators
- Low-side switches
- Battery-driven devices
- Power management
- MOSFET drivers
- Amplifiers

### 1.4 Quick reference data

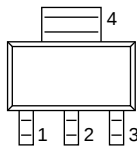
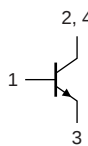
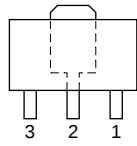
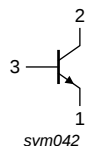
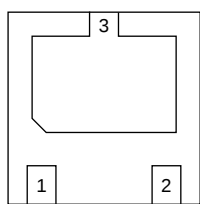
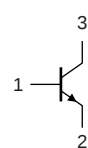
Table 2. Quick reference data

| Symbol    | Parameter                 | Conditions                                    | Min | Typ | Max | Unit |
|-----------|---------------------------|-----------------------------------------------|-----|-----|-----|------|
| $V_{CE0}$ | collector-emitter voltage | open base                                     | -   | -   | 80  | V    |
| $I_C$     | collector current         |                                               | -   | -   | 1   | A    |
| $I_{CM}$  | peak collector current    | single pulse; $t_p \leq 1$ ms                 | -   | -   | 2   | A    |
| $h_{FE}$  | DC current gain           | $V_{CE} = 2$ V; $I_C = 150$ mA <sup>[1]</sup> | 63  | -   | 250 |      |
|           | $h_{FE}$ selection -10    | $V_{CE} = 2$ V; $I_C = 150$ mA <sup>[1]</sup> | 63  | -   | 160 |      |
|           | $h_{FE}$ selection -16    | $V_{CE} = 2$ V; $I_C = 150$ mA <sup>[1]</sup> | 100 | -   | 250 |      |

[1] Pulse test:  $t_p \leq 300$   $\mu$ s;  $\delta = 0.02$ .

## 2. Pinning information

Table 3. Pinning

| Pin     | Description | Simplified outline                                                                                           | Graphic symbol                                                                                  |
|---------|-------------|--------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| SOT223  |             |                                                                                                              |                                                                                                 |
| 1       | base        |                           | <br>sym016   |
| 2       | collector   |                                                                                                              |                                                                                                 |
| 3       | emitter     |                                                                                                              |                                                                                                 |
| 4       | collector   |                                                                                                              |                                                                                                 |
| SOT89   |             |                                                                                                              |                                                                                                 |
| 1       | emitter     |                           | <br>sym042   |
| 2       | collector   |                                                                                                              |                                                                                                 |
| 3       | base        |                                                                                                              |                                                                                                 |
| SOT1061 |             |                                                                                                              |                                                                                                 |
| 1       | base        | <br>Transparent top view | <br>sym021 |
| 2       | emitter     |                                                                                                              |                                                                                                 |
| 3       | collector   |                                                                                                              |                                                                                                 |

## 3. Ordering information

Table 4. Ordering information

| Type number <sup>[1]</sup> | Package |                                                                                                        |         |
|----------------------------|---------|--------------------------------------------------------------------------------------------------------|---------|
|                            | Name    | Description                                                                                            | Version |
| BCP56                      | SC-73   | plastic surface-mounted package with increased heatsink; 4 leads                                       | SOT223  |
| BCX56                      | SC-62   | plastic surface-mounted package; exposed die pad for good heat transfer; 3 leads                       | SOT89   |
| BC56PA                     | HUSON3  | plastic thermal enhanced ultra thin small outline package; no leads; 3 terminals; body 2 × 2 × 0.65 mm | SOT1061 |

[1] Valid for all available selection groups.

## 4. Marking

Table 5. Marking codes

| Type number | Marking code |
|-------------|--------------|
| BCP56       | BCP56        |
| BCP56-10    | BCP56/10     |
| BCP56-16    | BCP56/16     |
| BCX56       | BH           |
| BCX56-10    | BK           |
| BCX56-16    | BL           |
| BC56PA      | AZ           |
| BC56-10PA   | BK           |
| BC56-16PA   | BL           |

## 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                           | -                    | 100  | V    |     |
| V <sub>CEO</sub> | collector-emitter voltage | open base                              | -                    | 80   | V    |     |
| V <sub>EBO</sub> | emitter-base voltage      | open collector                         | -                    | 5    | V    |     |
| I <sub>C</sub>   | collector current         |                                        | -                    | 1    | A    |     |
| I <sub>CM</sub>  | peak collector current    | single pulse;<br>t <sub>p</sub> ≤ 1 ms | -                    | 2    | A    |     |
| I <sub>B</sub>   | base current              |                                        | -                    | 0.3  | A    |     |
| I <sub>BM</sub>  | peak base current         | single pulse;<br>t <sub>p</sub> ≤ 1 ms | -                    | 0.3  | A    |     |
| P <sub>tot</sub> | total power dissipation   | T <sub>amb</sub> ≤ 25 °C               |                      |      |      |     |
|                  |                           |                                        |                      |      |      |     |
|                  | BCP56                     |                                        | <a href="#">[1]</a>  | -    | 0.65 | W   |
|                  |                           |                                        | <a href="#">[2]</a>  | -    | 1.00 | W   |
|                  |                           |                                        | <a href="#">[3]</a>  | -    | 1.35 | W   |
|                  | BCX56                     |                                        | <a href="#">[1]</a>  | -    | 0.50 | W   |
|                  |                           |                                        | <a href="#">[2]</a>  | -    | 0.95 | W   |
|                  |                           |                                        | <a href="#">[3]</a>  | -    | 1.35 | W   |
|                  | BC56PA                    |                                        | <a href="#">[1]</a>  | -    | 0.42 | W   |
|                  |                           |                                        | <a href="#">[2]</a>  | -    | 0.83 | W   |
|                  |                           |                                        | <a href="#">[3]</a>  | -    | 1.10 | W   |
|                  |                           |                                        | <a href="#">[4]</a>  | -    | 0.81 | W   |
|                  |                           |                                        | <a href="#">[5]</a>  | -    | 1.65 | W   |
|                  | T <sub>j</sub>            |                                        | junction temperature |      | -    | 150 |
| T <sub>amb</sub> | ambient temperature       |                                        | -55                  | +150 | °C   |     |
| T <sub>stg</sub> | 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>.

[4] Device mounted on an FR4 PCB, 4-layer copper, tin-plated and standard footprint.

[5] Device mounted on an FR4 PCB, 4-layer copper, tin-plated, mounting pad for collector 1 cm<sup>2</sup>.



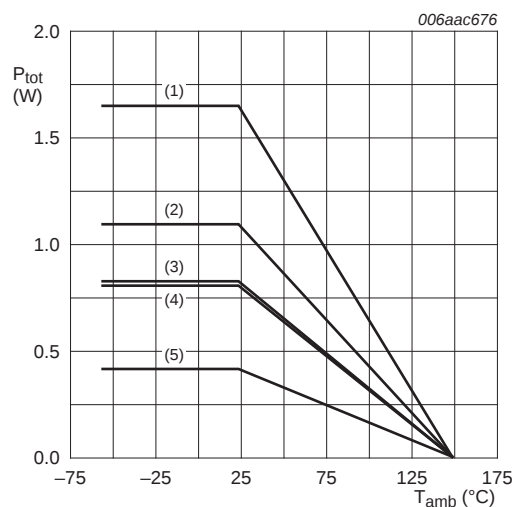
- (1) FR4 PCB, mounting pad for collector 6 cm<sup>2</sup>
- (2) FR4 PCB, mounting pad for collector 1 cm<sup>2</sup>
- (3) FR4 PCB, standard footprint

Fig 1. 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 2. Power derating curves SOT89



- (1) FR4 PCB, 4-layer copper, mounting pad for collector 1 cm<sup>2</sup>
- (2) FR4 PCB, single-sided copper, mounting pad for collector 6 cm<sup>2</sup>
- (3) FR4 PCB, single-sided copper, mounting pad for collector 1 cm<sup>2</sup>
- (4) FR4 PCB, 4-layer copper, standard footprint
- (5) FR4 PCB, single-sided copper, standard footprint

Fig 3. Power derating curves SOT1061

## 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] | -   | -   | 192 K/W |
|                |                                                  |             | [2] | -   | -   | 125 K/W |
|                |                                                  |             | [3] | -   | -   | 93 K/W  |
|                |                                                  |             | [1] | -   | -   | 250 K/W |
|                |                                                  |             | [2] | -   | -   | 132 K/W |
|                |                                                  |             | [3] | -   | -   | 93 K/W  |
|                |                                                  |             | [1] | -   | -   | 298 K/W |
|                |                                                  |             | [2] | -   | -   | 151 K/W |
|                |                                                  |             | [3] | -   | -   | 114 K/W |
|                |                                                  |             | [4] | -   | -   | 154 K/W |
|                |                                                  |             | [5] | -   | -   | 76 K/W  |
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point |             |     |     |     |         |
|                |                                                  | BCP56       | -   | -   | 16  | K/W     |
|                |                                                  | BCX56       | -   | -   | 16  | K/W     |
|                |                                                  | BC56PA      | -   | -   | 20  | 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>.

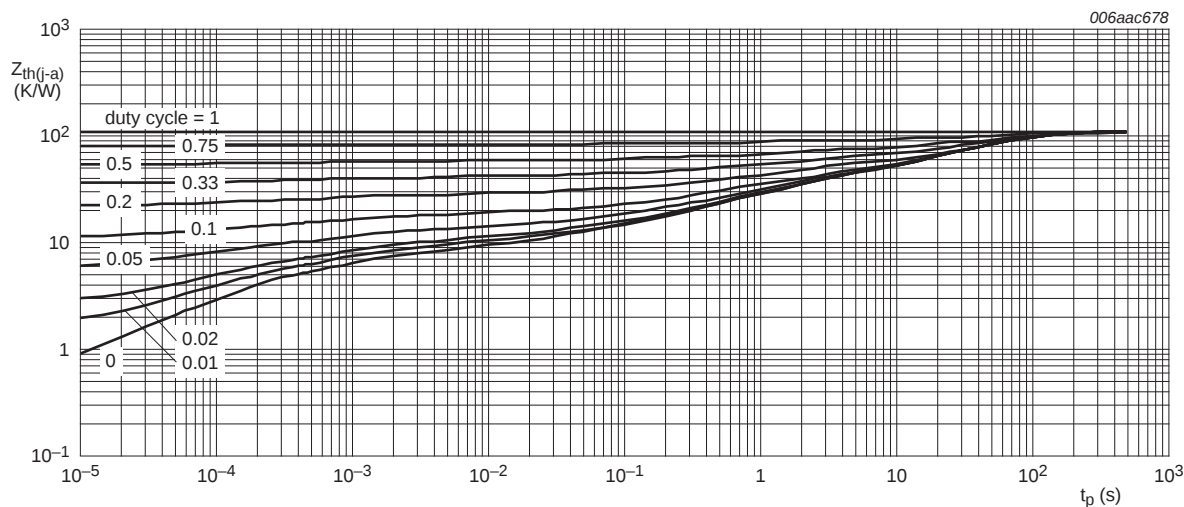
[4] Device mounted on an FR4 PCB, 4-layer copper, tin-plated and standard footprint.

[5] Device mounted on an FR4 PCB, 4-layer copper, tin-plated, mounting pad for collector 1 cm<sup>2</sup>.



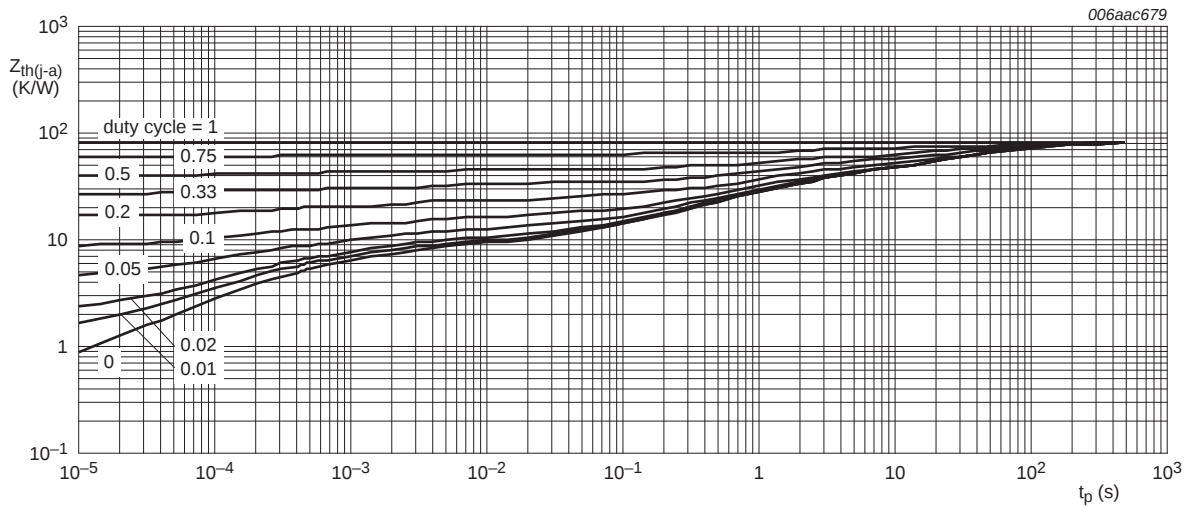
FR4 PCB, standard footprint

Fig. 4. Transient thermal impedance from junction to ambient as a function of pulse duration for SOT223; typical values



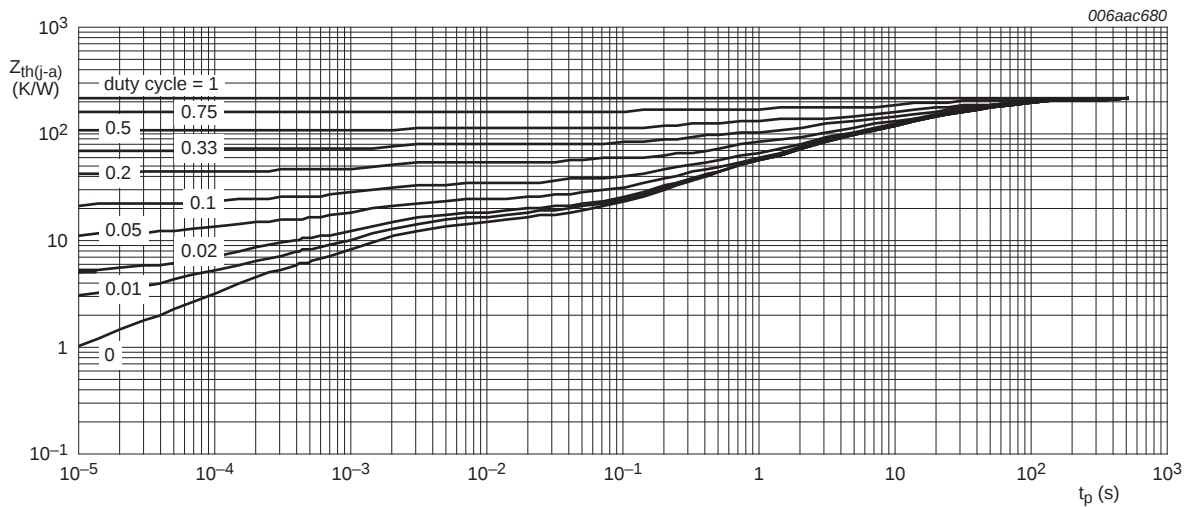
FR4 PCB, mounting pad for collector  $1\text{ cm}^2$

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



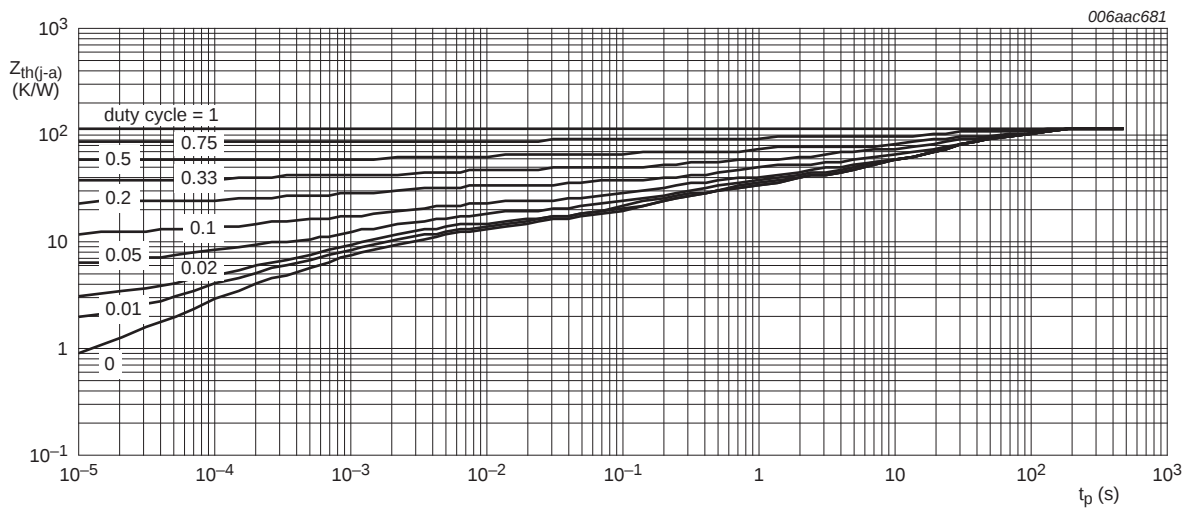
FR4 PCB, mounting pad for collector 6 cm<sup>2</sup>

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



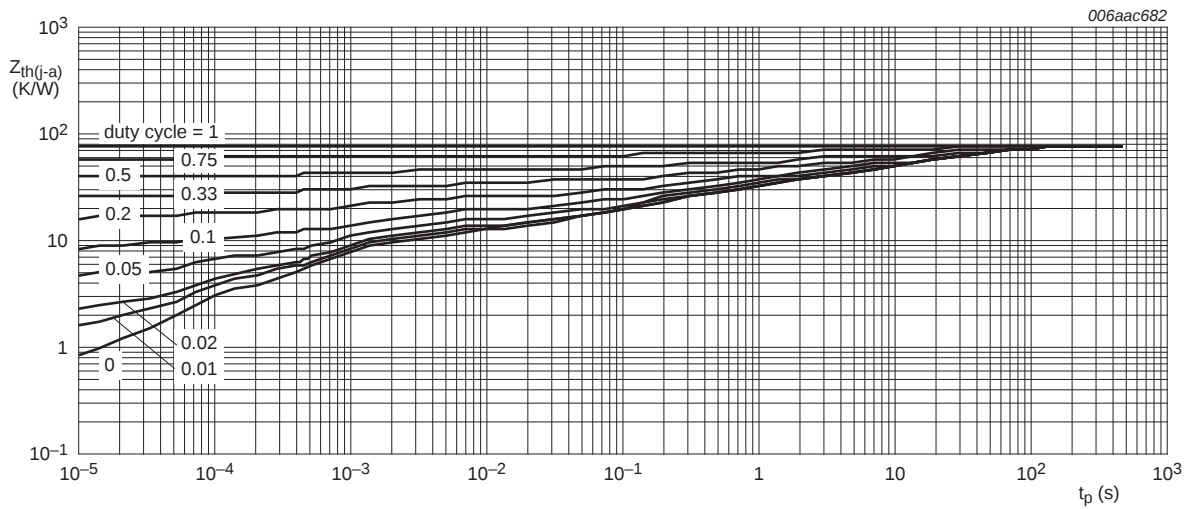
FR4 PCB, standard footprint

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**



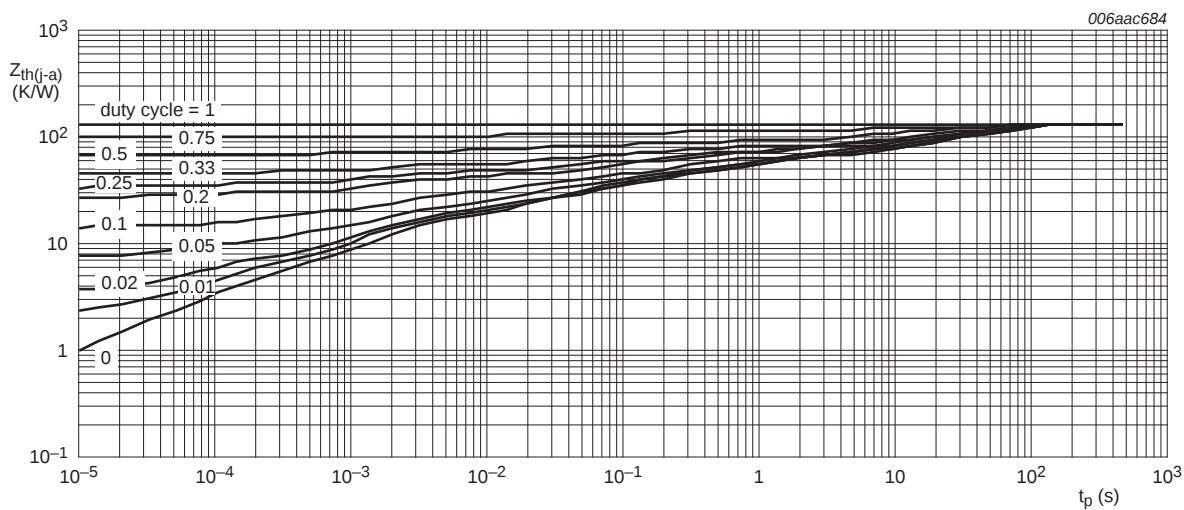
FR4 PCB, mounting pad for collector 6 cm<sup>2</sup>

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



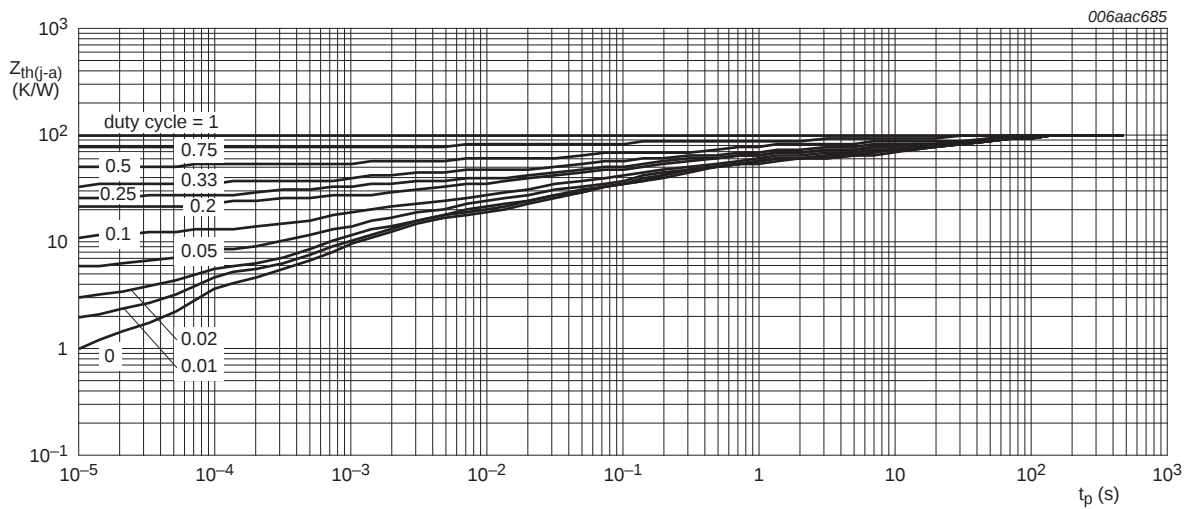
FR4 PCB, single-sided copper, standard footprint

Fig 10. Transient thermal impedance from junction to ambient as a function of pulse duration for SOT1061; typical values



FR4 PCB, single-sided copper, mounting pad for collector 1 cm<sup>2</sup>

Fig 11. Transient thermal impedance from junction to ambient as a function of pulse duration for SOT1061; typical values



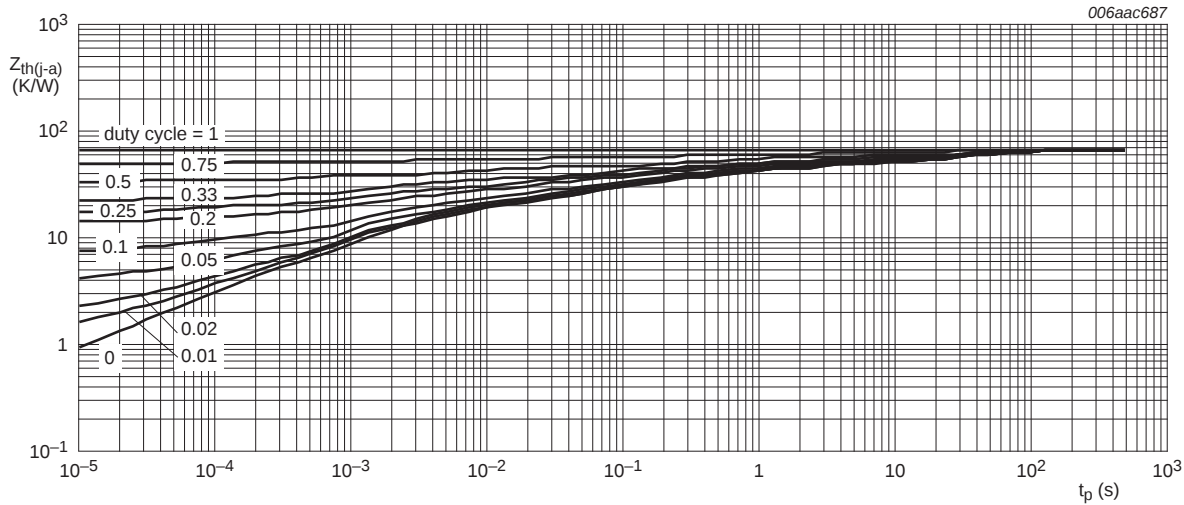
FR4 PCB, single-sided copper, mounting pad for collector 6 cm<sup>2</sup>

Fig 12. Transient thermal impedance from junction to ambient as a function of pulse duration for SOT1061; typical values



FR4 PCB, 4-layer copper, standard footprint

Fig 13. Transient thermal impedance from junction to ambient as a function of pulse duration for SOT1061; typical values



FR4 PCB, 4-layer copper, mounting pad for collector 1 cm<sup>2</sup>

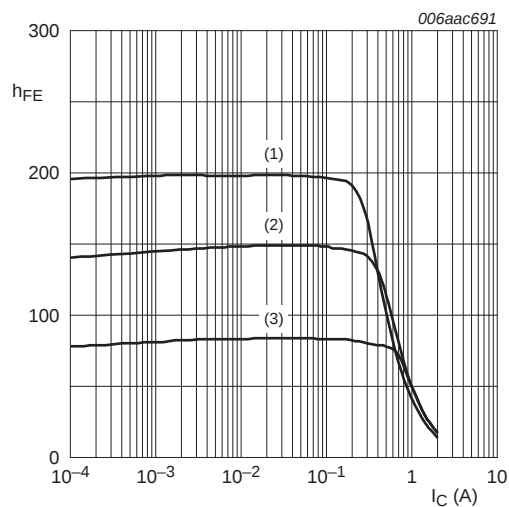
Fig 14. Transient thermal impedance from junction to ambient as a function of pulse duration for SOT1061; typical values

7. Characteristics

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

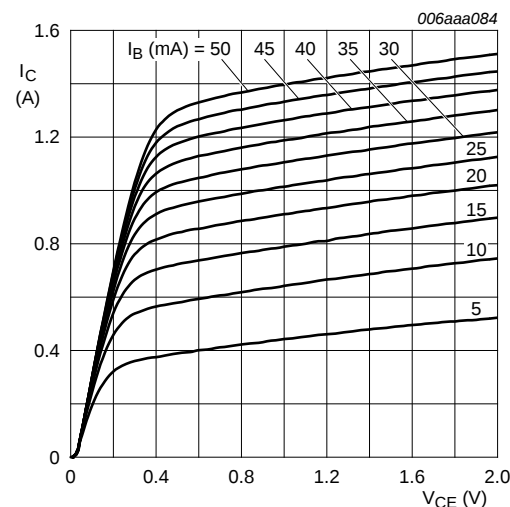
| Symbol      | Parameter                            | Conditions                                                       | Min     | Typ | Max | Unit |
|-------------|--------------------------------------|------------------------------------------------------------------|---------|-----|-----|------|
| $I_{CBO}$   | collector-base cut-off current       | $V_{CB} = 30\text{ V}; I_E = 0\text{ A}$                         | -       | -   | 100 | nA   |
|             |                                      | $V_{CB} = 30\text{ V}; I_E = 0\text{ A}; T_j = 150\text{ °C}$    | -       | -   | 10  | μA   |
| $I_{EBO}$   | emitter-base cut-off current         | $V_{EB} = 5\text{ V}; I_C = 0\text{ A}$                          | -       | -   | 100 | nA   |
| $h_{FE}$    | DC current gain                      | $V_{CE} = 2\text{ V}$                                            |         |     |     |      |
|             |                                      | $I_C = 5\text{ mA}$                                              | [1] 63  | -   | -   |      |
|             |                                      | $I_C = 150\text{ mA}$                                            | [1] 63  | -   | 250 |      |
|             |                                      | $I_C = 500\text{ mA}$                                            | [1] 40  | -   | -   |      |
|             | DC current gain                      | $V_{CE} = 2\text{ V}$                                            |         |     |     |      |
|             |                                      |                                                                  |         |     |     |      |
|             | $h_{FE}$ selection -10               | $I_C = 150\text{ mA}$                                            | [1] 63  | -   | 160 |      |
|             | $h_{FE}$ selection -16               | $I_C = 150\text{ mA}$                                            | [1] 100 | -   | 250 |      |
| $V_{CEsat}$ | collector-emitter saturation voltage | $I_C = 500\text{ mA}; I_B = 50\text{ mA}$                        | [1] -   | -   | 0.5 | V    |
| $V_{BE}$    | base-emitter voltage                 | $V_{CE} = 2\text{ V}; I_C = 500\text{ mA}$                       | [1] -   | -   | 1   | V    |
| $C_c$       | collector capacitance                | $V_{CB} = 10\text{ V}; I_E = i_e = 0\text{ A}; f = 1\text{ MHz}$ | -       | 6   | -   | pF   |
| $f_T$       | transition frequency                 | $V_{CE} = 5\text{ V}; I_C = 50\text{ mA}; f = 100\text{ MHz}$    | 100     | 180 | -   | MHz  |

[1] Pulse test:  $t_p \leq 300\text{ μs}; \delta = 0.02$ .



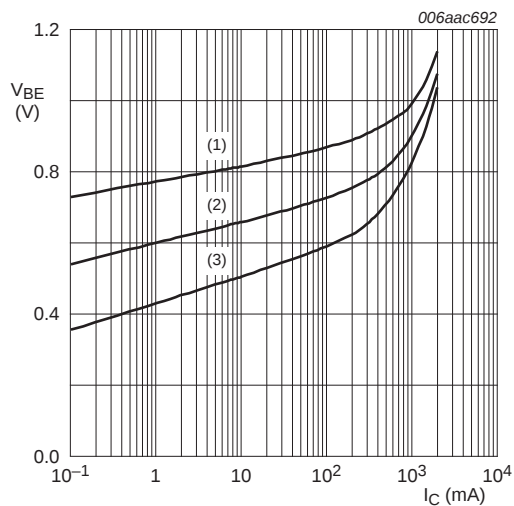
- $V_{CE} = 2\text{ V}$
- (1)  $T_{amb} = 100\text{ °C}$
  - (2)  $T_{amb} = 25\text{ °C}$
  - (3)  $T_{amb} = -55\text{ °C}$

Fig 15. DC current gain as a function of collector current; typical values



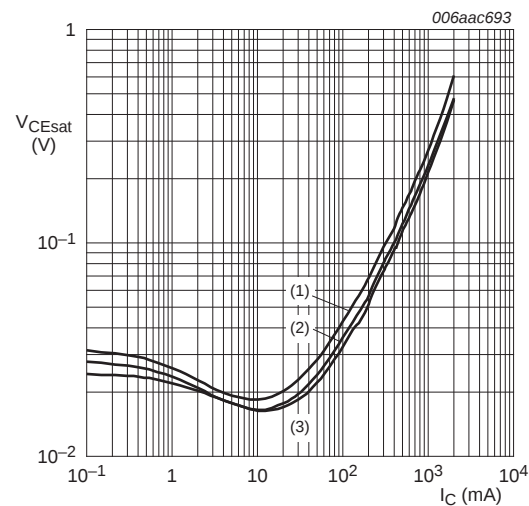
$T_{amb} = 25\text{ °C}$

Fig 16. Collector current as a function of collector-emitter voltage; typical values



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

Fig 17. Base-emitter voltage as a function of collector current; typical values



- $I_C/I_B = 10$
- (1)  $T_{amb} = 100\text{ °C}$
  - (2)  $T_{amb} = 25\text{ °C}$
  - (3)  $T_{amb} = -55\text{ °C}$

Fig 18. Collector-emitter saturation 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



Fig 19. Package outline SOT223 (SC-73)



Fig 20. Package outline SOT89 (SC-62/TO-243)



10. 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             | 3000 | 4000 |
| BCP56                      | SOT223  | 8 mm pitch, 12 mm tape and reel                    | -115             | -    | -135 |
| BCX56                      | 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> | -146             | -    | -    |
| BC56PA                     | SOT1061 | 4 mm pitch, 8 mm tape and reel                     | -                | -115 | -    |

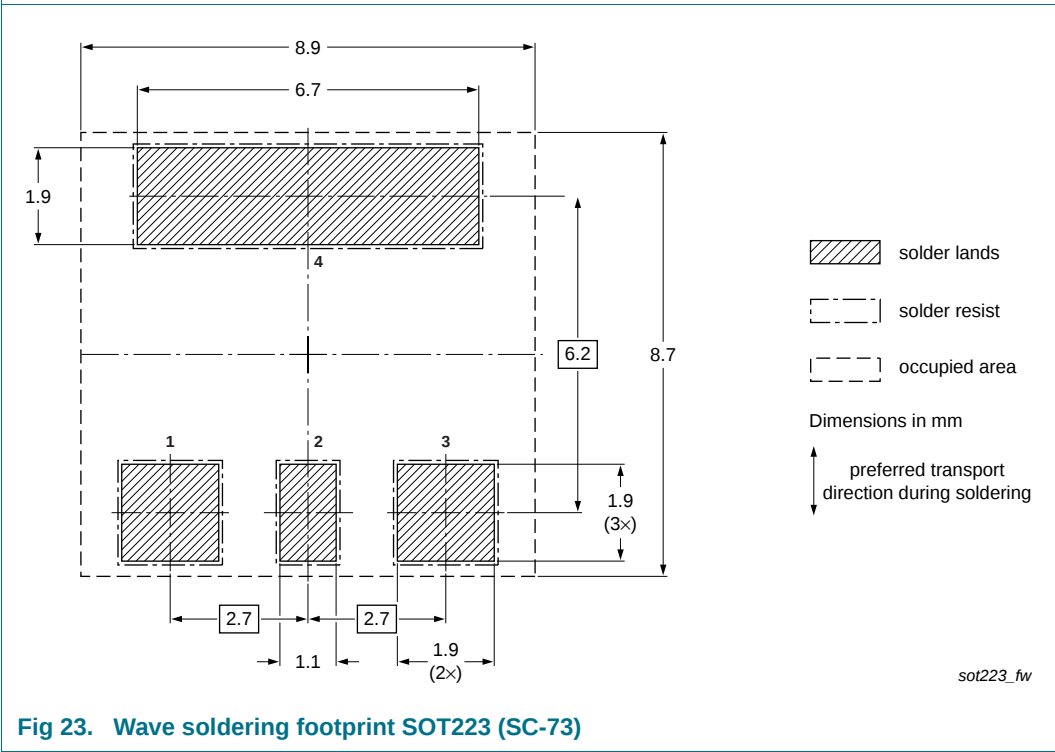
[1] For further information and the availability of packing methods, see [Section 14](#).

[2] Valid for all available selection groups.

[3] T1: normal taping

[4] T3: 90° rotated taping

11. Soldering



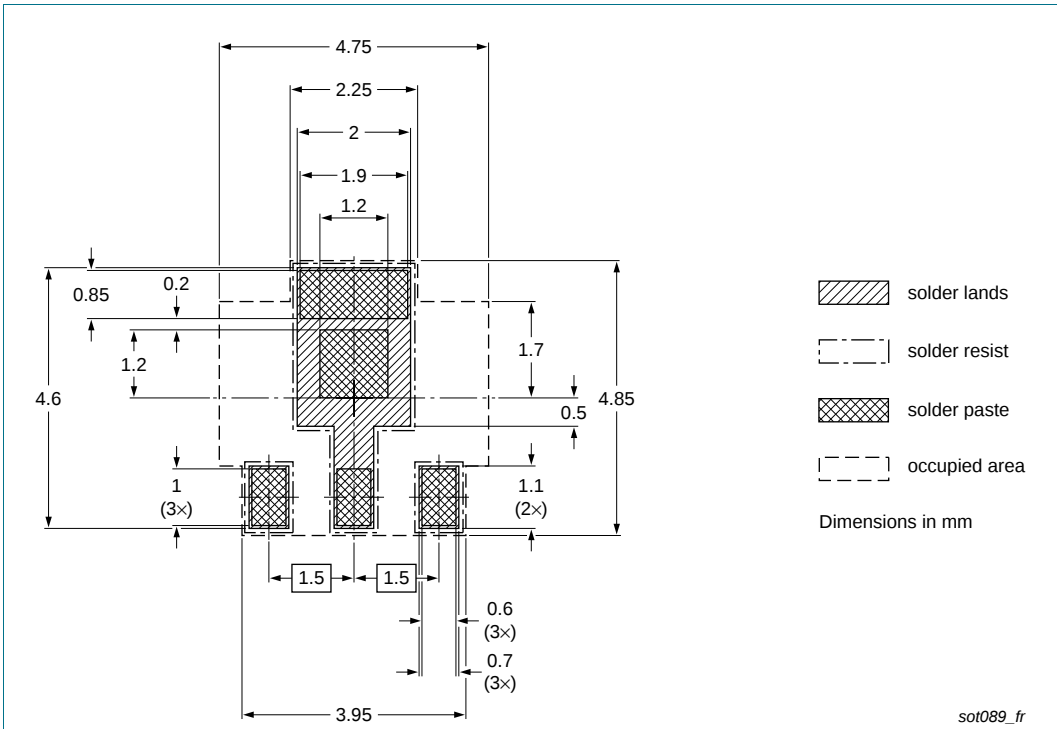


Fig 24. Reflow soldering footprint SOT89 (SC-62/TO-243)

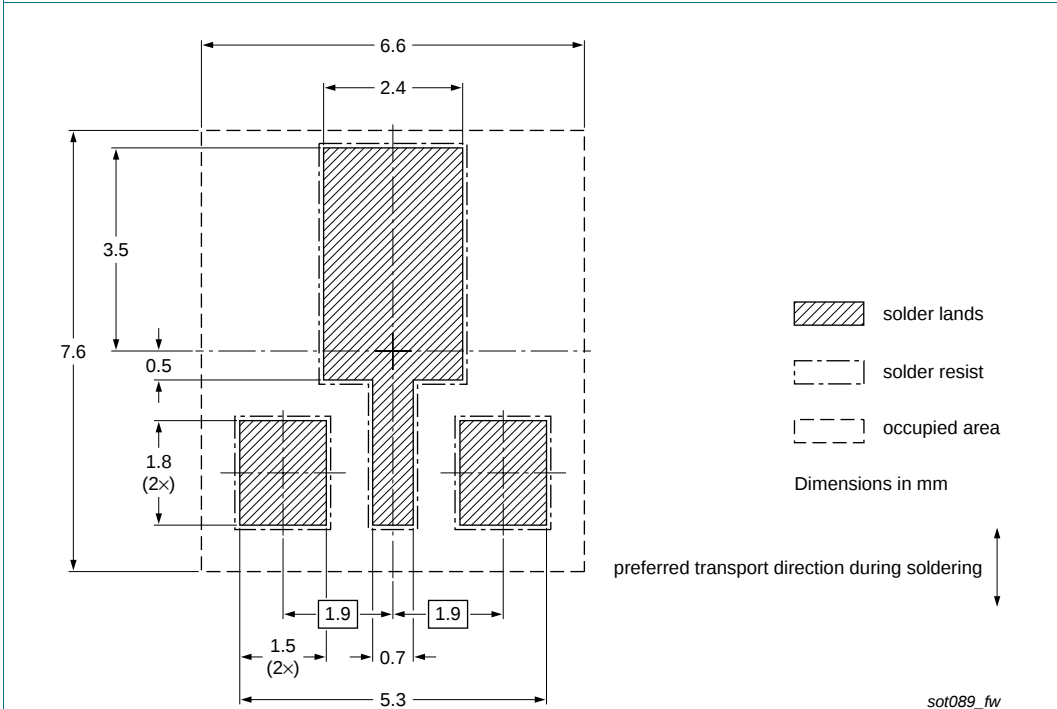
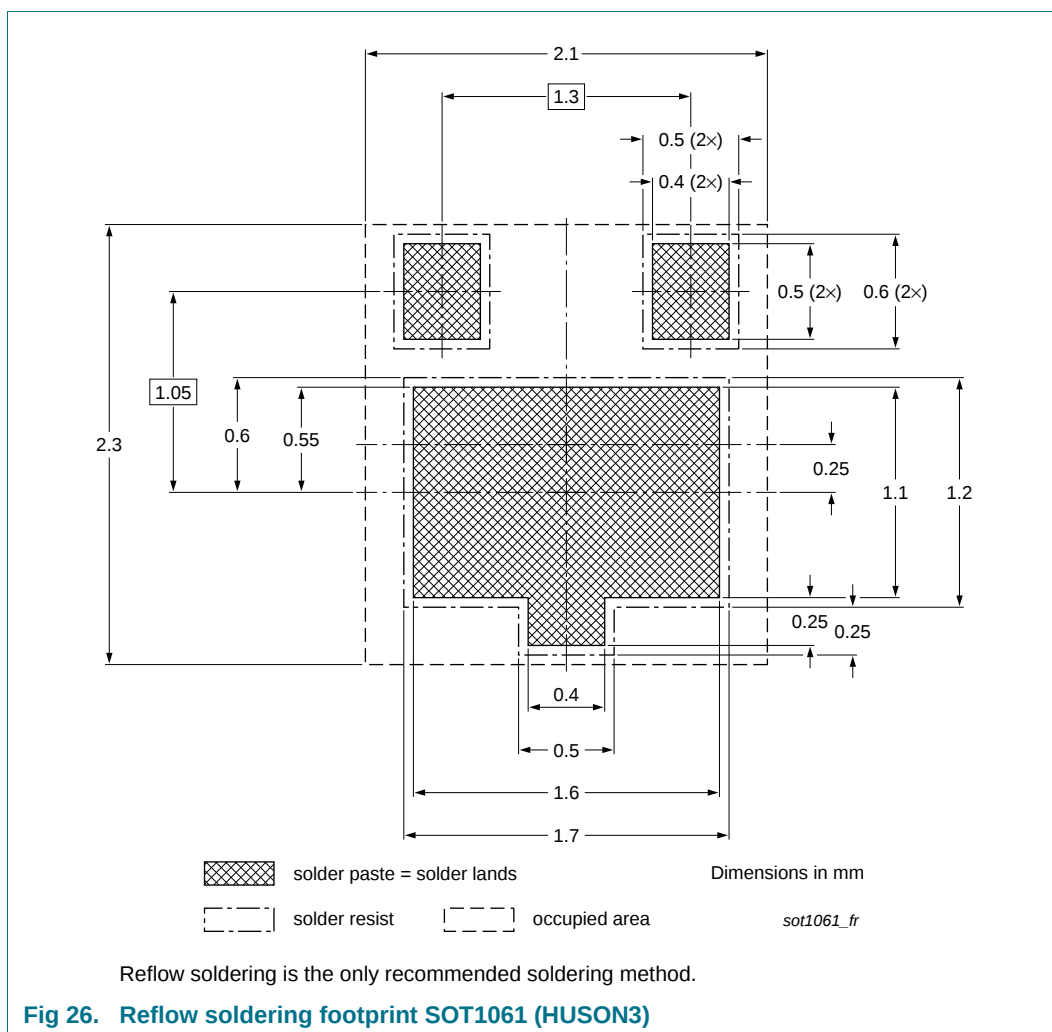


Fig 25. Wave soldering footprint SOT89 (SC-62/TO-243)



## 12. Revision history

Table 10. Revision history

| Document ID                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Release date | Data sheet status     | Change notice | Supersedes                                              |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-----------------------|---------------|---------------------------------------------------------|
| BCP56_BCX56_BC56PA v.9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 20111025     | Product data sheet    | -             | BC639_BCP56_BCX56 v.8                                   |
| Modifications: <ul style="list-style-type: none"> <li>Type number removed: BC639</li> <li>Type number added: BC56PA, BC56-10PA and BC56-16PA</li> <li><a href="#">Section 1 "Product profile"</a>: updated</li> <li><a href="#">Section 2 "Pinning information"</a>: updated</li> <li><a href="#">Table 6</a> and <a href="#">7</a>: updated according to latest measurements</li> <li><a href="#">Figure 1</a>, <a href="#">2</a>, <a href="#">4</a>, <a href="#">5</a>, <a href="#">7</a> to <a href="#">9</a>, <a href="#">15</a>, <a href="#">17</a> and <a href="#">18</a>: updated</li> <li><a href="#">Figure 3</a>, <a href="#">6</a>, <a href="#">10</a> to <a href="#">14</a>: added</li> <li><a href="#">Section 8 "Test information"</a>: added</li> <li><a href="#">Section 10 "Packing information"</a>: updated</li> <li><a href="#">Section 11 "Soldering"</a>: added</li> <li><a href="#">Section 13 "Legal information"</a>: updated</li> </ul> |              |                       |               |                                                         |
| BC639_BCP56_BCX56 v.8                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 20070622     | Product data sheet    | -             | BC639_BCP56_BCX56 v.7                                   |
| BC639_BCP56_BCX56 v.7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 20050308     | Product data sheet    | -             | BC639_BCP56_BCX56 v.6                                   |
| BC639_BCP56_BCX56 v.6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 20050303     | Product data sheet    | CPCN200405029 | BC635_637_639 v.4<br>BCP54_55_56 v.5<br>BCX54_55_56 v.4 |
| BC635_637_639 v.4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 20011010     | Product specification | -             | BC635_637_639 v.3                                       |
| BCP54_55_56 v.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 20030206     | Product specification | -             | BCP54_55_56 v.4                                         |
| BCX54_55_56 v.4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 20011010     | Product specification | -             | BCX54_55_56 v.3                                         |

## 13. Legal information

### 13.1 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.nexperia.com>.

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**Quick reference data** — The Quick reference data is an extract of the product data given in the Limiting values and Characteristics sections of this document, and as such is not complete, exhaustive or legally binding.

## 13.4 Trademarks

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.

## 14. Contact information

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For more information, please visit: <http://www.nexperia.com>

For sales office addresses, please send an email to: [salesaddresses@nexperia.com](mailto:salesaddresses@nexperia.com)

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