

# BC847 series

45 V, 100 mA NPN general-purpose transistors

Rev. 9 — 23 September 2014

Product data sheet

## 1. Product profile

### 1.1 General description

NPN general-purpose transistors in Surface-Mounted Device (SMD) plastic packages.

Table 1. Product overview

| Type number <sup>[1]</sup> | Package |        |          | PNP complement |
|----------------------------|---------|--------|----------|----------------|
|                            | NXP     | JEITA  | JEDEC    |                |
| BC847                      | SOT23   | -      | TO-236AB | BC857          |
| BC847A                     |         |        |          | BC857A         |
| BC847B                     |         |        |          | BC857B         |
| BC847C                     |         |        |          | BC857C         |
| BC847W                     | SOT323  | SC-70  | -        | BC857W         |
| BC847AW                    |         |        |          | BC857AW        |
| BC847BW                    |         |        |          | BC857BW        |
| BC847CW                    |         |        |          | BC857CW        |
| BC847T                     | SOT416  | SC-75  | -        | BC857T         |
| BC847AT                    |         |        |          | BC857AT        |
| BC847BT                    |         |        |          | BC857BT        |
| BC847CT                    |         |        |          | BC857CT        |
| BC847AM                    | SOT883  | SC-101 | -        | BC857AM        |
| BC847BM                    |         |        |          | BC857BM        |
| BC847CM                    |         |        |          | BC857CM        |

[1] Valid for all available selection groups.

### 1.2 Features and benefits

- General-purpose transistors
- SMD plastic packages
- Three different gain selections
- AEC-Q101 qualified

### 1.3 Applications

- General-purpose switching and amplification



## 1.4 Quick reference data

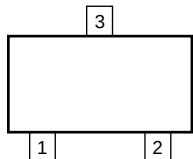
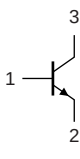
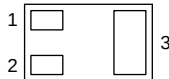
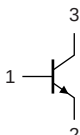
Table 2. Quick reference data

| Symbol    | Parameter                 | Conditions                               |     | Min | Typ | Max | Unit |
|-----------|---------------------------|------------------------------------------|-----|-----|-----|-----|------|
| $V_{CEO}$ | collector-emitter voltage | open base                                |     | -   | -   | 45  | V    |
| $I_C$     | collector current         |                                          |     | -   | -   | 100 | mA   |
| $h_{FE}$  | DC current gain           | $V_{CE} = 5\text{ V}; I_C = 2\text{ mA}$ | [1] | 110 | -   | 800 |      |
|           | $h_{FE}$ group A          |                                          |     | 110 | 180 | 220 |      |
|           | $h_{FE}$ group B          |                                          |     | 200 | 290 | 450 |      |
|           | $h_{FE}$ group C          |                                          |     | 420 | 520 | 800 |      |

[1]  $T_{amb} = 25\text{ °C}$  unless otherwise specified

## 2. Pinning information

Table 3. Pinning

| Pin                   | Description |  | Simplified outline                                                                                            | Graphic symbol                                                                                  |
|-----------------------|-------------|--|---------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| SOT23, SOT323, SOT416 |             |  |                                                                                                               |                                                                                                 |
| 1                     | base        |  | <br>006aaa144             | <br>sym021  |
| 2                     | emitter     |  |                                                                                                               |                                                                                                 |
| 3                     | collector   |  |                                                                                                               |                                                                                                 |
| SOT883                |             |  |                                                                                                               |                                                                                                 |
| 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 |
| BC847                      | -       | plastic surface-mounted package; 3 leads                                         | SOT23   |
| BC847A                     |         |                                                                                  |         |
| BC847B                     |         |                                                                                  |         |
| BC847C                     |         |                                                                                  |         |
| BC847W                     | SC-70   | plastic surface-mounted package; 3 leads                                         | SOT323  |
| BC847AW                    |         |                                                                                  |         |
| BC847BW                    |         |                                                                                  |         |
| BC847CW                    |         |                                                                                  |         |
| BC847T                     | SC-75   | plastic surface-mounted package; 3 leads                                         | SOT416  |
| BC847AT                    |         |                                                                                  |         |
| BC847BT                    |         |                                                                                  |         |
| BC847CT                    |         |                                                                                  |         |
| BC847AM                    | SC-101  | leadless ultra small plastic package; 3 solder lands;<br>body 1.0 × 0.6 × 0.5 mm | SOT883  |
| BC847BM                    |         |                                                                                  |         |
| BC847CM                    |         |                                                                                  |         |

[1] Valid for all available selection groups.

### 4. Marking

Table 5. Marking codes

| Type number | Marking code <sup>[1]</sup> | Type number | Marking code <sup>[1]</sup> |
|-------------|-----------------------------|-------------|-----------------------------|
| BC847       | 1H*                         | BC847T      | 1N                          |
| BC847A      | 1E*                         | BC847AT     | 1E                          |
| BC847B      | 1F*                         | BC847BT     | 1F                          |
| BC847C      | 1G*                         | BC847CT     | 1G                          |
| BC847W      | 1H*                         | BC847AM     | D4                          |
| BC847AW     | 1E*                         | BC847BM     | D5                          |
| BC847BW     | 1F*                         | BC847CM     | D6                          |
| BC847CW     | 1G*                         |             |                             |

[1] \* = placeholder for manufacturing site code

## 5. Limiting values

**Table 6. Limiting values**

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

| Symbol    | Parameter                 | Conditions                       |     | Min | Max  | Unit |
|-----------|---------------------------|----------------------------------|-----|-----|------|------|
| $V_{CBO}$ | collector-base voltage    | open emitter                     |     | -   | 50   | V    |
| $V_{CEO}$ | collector-emitter voltage | open base                        |     | -   | 45   | V    |
| $V_{EBO}$ | emitter-base voltage      | open collector                   |     | -   | 6    | V    |
| $I_C$     | collector current         |                                  |     | -   | 100  | mA   |
| $I_{CM}$  | peak collector current    | single pulse;<br>$t_p \leq 1$ ms |     | -   | 200  | mA   |
| $I_{BM}$  | peak base current         | single pulse;<br>$t_p \leq 1$ ms |     | -   | 100  | mA   |
| $P_{tot}$ | total power dissipation   | $T_{amb} \leq 25$ °C             | [1] |     |      |      |
|           | SOT23                     |                                  |     | -   | 250  | mW   |
|           | SOT323                    |                                  |     | -   | 200  | mW   |
|           | SOT416                    |                                  |     | -   | 150  | mW   |
|           | SOT883                    |                                  | [2] | -   | 250  | mW   |
| $T_j$     | junction temperature      |                                  |     | -   | 150  | °C   |
| $T_{amb}$ | ambient temperature       |                                  |     | -65 | +150 | °C   |
| $T_{stg}$ | storage temperature       |                                  |     | -65 | +150 | °C   |

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

[2] Device mounted on an FR4 PCB with 60 µm copper strip line, standard footprint.

## 6. Thermal characteristics

**Table 7. Thermal characteristics**

| Symbol        | Parameter                                   | Conditions  |     | Min | Typ | Max | Unit |
|---------------|---------------------------------------------|-------------|-----|-----|-----|-----|------|
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | in free air | [1] |     |     |     |      |
|               | SOT23                                       |             |     | -   | -   | 500 | K/W  |
|               | SOT323                                      |             |     | -   | -   | 625 | K/W  |
|               | SOT416                                      |             |     | -   | -   | 833 | K/W  |
|               | SOT883                                      |             | [2] | -   | -   | 500 | K/W  |

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

[2] Device mounted on an FR4 PCB with 60 µm copper strip line, standard footprint.

## 7. Characteristics

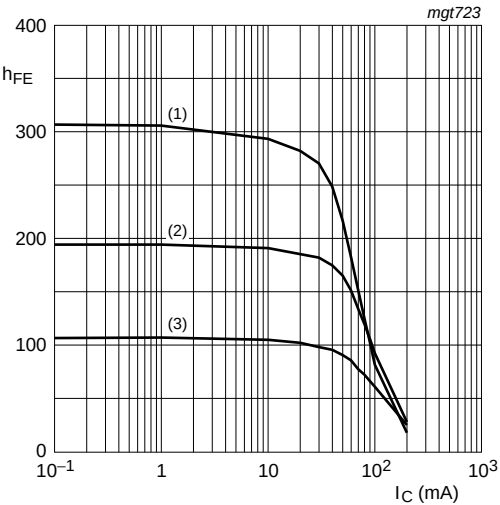
**Table 8. Characteristics**

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

| Symbol             | Parameter                            | Conditions                                                                                   |     | Min | Typ | Max | Unit |
|--------------------|--------------------------------------|----------------------------------------------------------------------------------------------|-----|-----|-----|-----|------|
| I <sub>CBO</sub>   | collector-base cut-off current       | V <sub>CB</sub> = 30 V; I <sub>E</sub> = 0 A                                                 |     | -   | -   | 15  | nA   |
|                    |                                      | V <sub>CB</sub> = 30 V; I <sub>E</sub> = 0 A; T <sub>j</sub> = 150 °C                        |     | -   | -   | 5   | 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> = 5 V; I <sub>C</sub> = 10 μA                                                |     |     |     |     |      |
|                    | h <sub>FE</sub> group A              |                                                                                              | -   | 170 | -   |     |      |
|                    | h <sub>FE</sub> group B              |                                                                                              | -   | 280 | -   |     |      |
|                    | h <sub>FE</sub> group C              |                                                                                              | -   | 420 | -   |     |      |
|                    | DC current gain                      | V <sub>CE</sub> = 5 V; I <sub>C</sub> = 2 mA                                                 | 110 | -   | 800 |     |      |
|                    | h <sub>FE</sub> group A              |                                                                                              | 110 | 180 | 220 |     |      |
|                    | h <sub>FE</sub> group B              |                                                                                              | 200 | 290 | 450 |     |      |
|                    | h <sub>FE</sub> group C              |                                                                                              | 420 | 520 | 800 |     |      |
| V <sub>CEsat</sub> | collector-emitter saturation voltage | I <sub>C</sub> = 10 mA; I <sub>B</sub> = 0.5 mA                                              |     | -   | 90  | 200 | mV   |
|                    |                                      | I <sub>C</sub> = 100 mA; I <sub>B</sub> = 5 mA                                               | [1] | -   | 200 | 400 | mV   |
| V <sub>BEsat</sub> | base-emitter saturation voltage      | I <sub>C</sub> = 10 mA; I <sub>B</sub> = 0.5 mA                                              | [2] | -   | 700 | -   | mV   |
|                    |                                      | I <sub>C</sub> = 100 mA; I <sub>B</sub> = 5 mA                                               | [2] | -   | 900 | -   | mV   |
| V <sub>BE</sub>    | base-emitter voltage                 | I <sub>C</sub> = 2 mA; V <sub>CE</sub> = 5 V                                                 | [2] | 580 | 660 | 700 | mV   |
|                    |                                      | I <sub>C</sub> = 10 mA; V <sub>CE</sub> = 5 V                                                |     | -   | -   | 770 | mV   |
| f <sub>T</sub>     | transition frequency                 | V <sub>CE</sub> = 5 V; I <sub>C</sub> = 10 mA; f = 100 MHz                                   |     | 100 | -   | -   | MHz  |
| 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                     |     | -   | -   | 1.5 | pF   |
| C <sub>e</sub>     | emitter capacitance                  | V <sub>EB</sub> = 0.5 V; I <sub>C</sub> = i <sub>c</sub> = 0 A; f = 1 MHz                    |     | -   | 11  | -   | pF   |
| NF                 | noise figure                         | I <sub>C</sub> = 200 μA; V <sub>CE</sub> = 5 V; R <sub>S</sub> = 2 kΩ; f = 1 kHz; B = 200 Hz |     | -   | 2   | 10  | dB   |

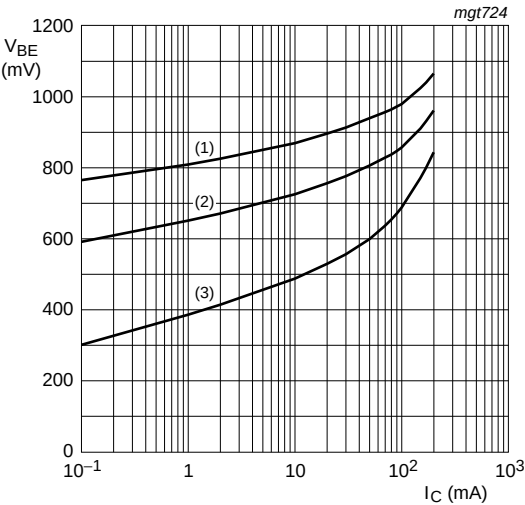
[1] Pulse test:  $t_p \leq 300\text{ }\mu\text{s}; \delta = 0.02$ .

[2]  $V_{BE}$  decreases by approximately 2 mV/K with increasing temperature.



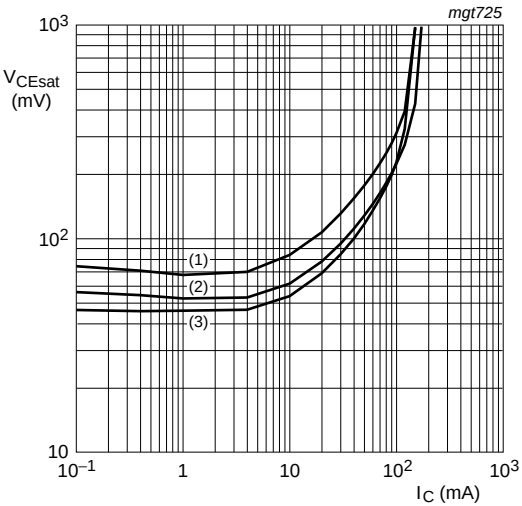
$V_{CE} = 5\text{ V}$   
(1)  $T_{amb} = 150^\circ\text{C}$   
(2)  $T_{amb} = 25^\circ\text{C}$   
(3)  $T_{amb} = -55^\circ\text{C}$

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



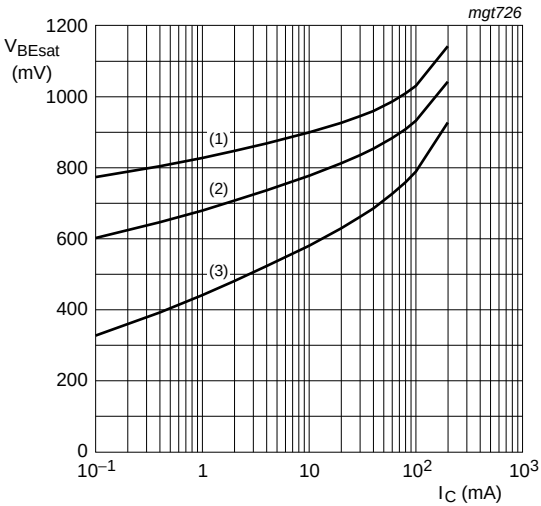
$V_{CE} = 5\text{ V}$   
(1)  $T_{amb} = -55^\circ\text{C}$   
(2)  $T_{amb} = 25^\circ\text{C}$   
(3)  $T_{amb} = 150^\circ\text{C}$

Fig 2. Group A: Base-emitter voltage as a function of collector current; typical values



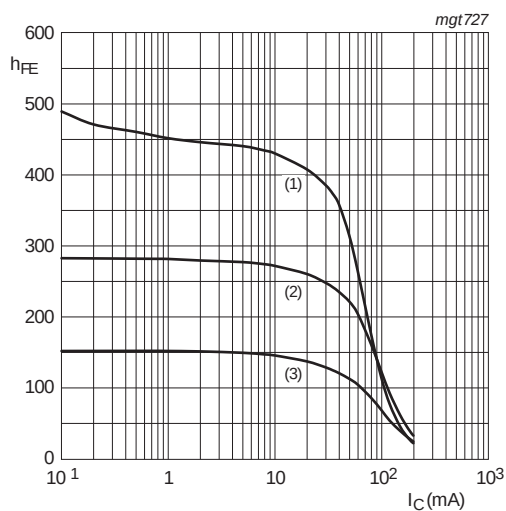
$I_C/I_B = 20$   
(1)  $T_{amb} = 150^\circ\text{C}$   
(2)  $T_{amb} = 25^\circ\text{C}$   
(3)  $T_{amb} = -55^\circ\text{C}$

Fig 3. Group A: Collector-emitter saturation voltage as a function of collector current; typical values



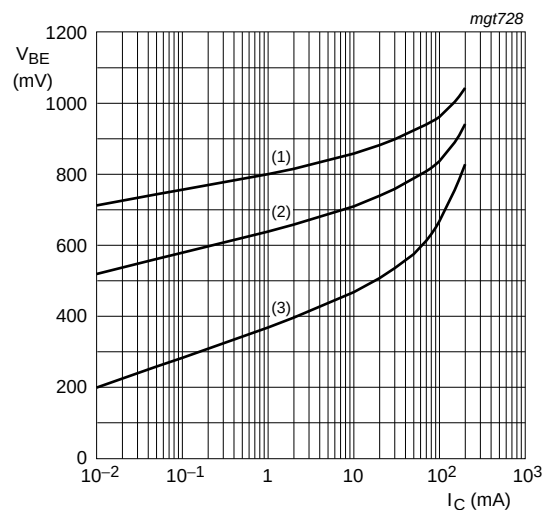
$I_C/I_B = 10$   
(1)  $T_{amb} = -55^\circ\text{C}$   
(2)  $T_{amb} = 25^\circ\text{C}$   
(3)  $T_{amb} = 150^\circ\text{C}$

Fig 4. Group A: Base-emitter saturation voltage as a function of collector current; typical values



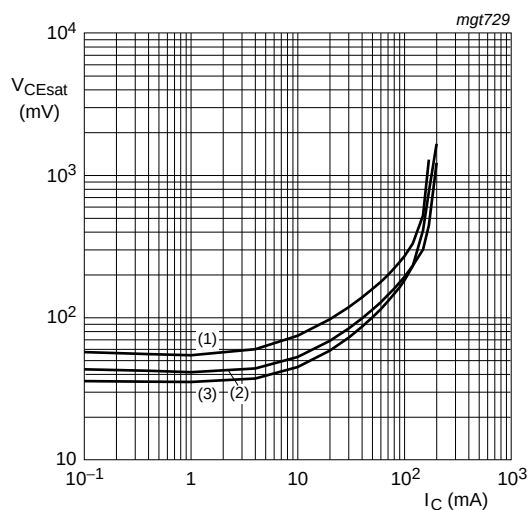
- $V_{CE} = 5\text{ V}$
- (1)  $T_{amb} = 150\text{ }^{\circ}\text{C}$
  - (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$
  - (3)  $T_{amb} = -55\text{ }^{\circ}\text{C}$

Fig 5. Group B: DC current gain as a function of collector current; typical values



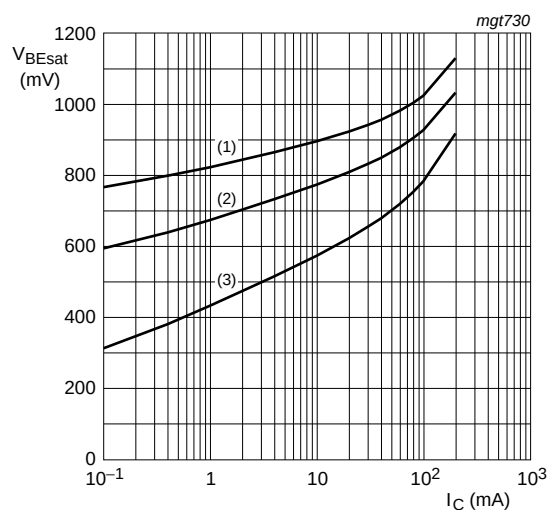
- $V_{CE} = 5\text{ V}$
- (1)  $T_{amb} = -55\text{ }^{\circ}\text{C}$
  - (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$
  - (3)  $T_{amb} = 150\text{ }^{\circ}\text{C}$

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



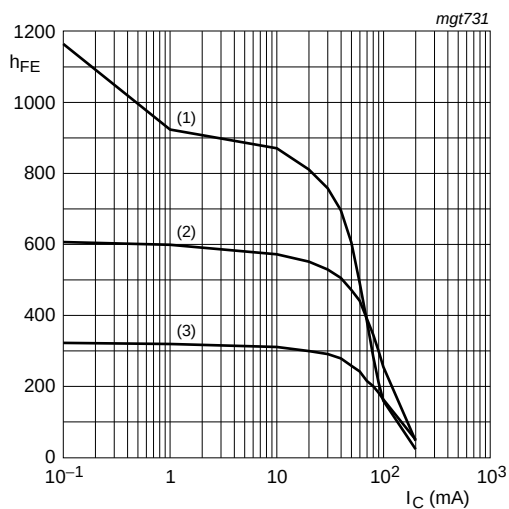
- $I_C/I_B = 20$
- (1)  $T_{amb} = 150\text{ }^{\circ}\text{C}$
  - (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$
  - (3)  $T_{amb} = -55\text{ }^{\circ}\text{C}$

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



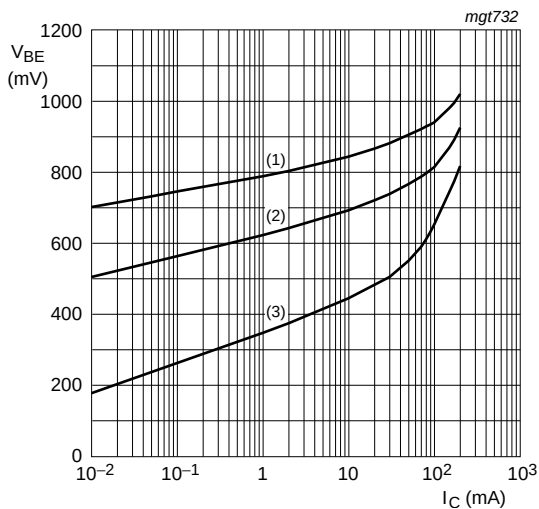
- $I_C/I_B = 10$
- (1)  $T_{amb} = -55\text{ }^{\circ}\text{C}$
  - (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$
  - (3)  $T_{amb} = 150\text{ }^{\circ}\text{C}$

Fig 8. Group B: Base-emitter saturation voltage as a function of collector current; typical values



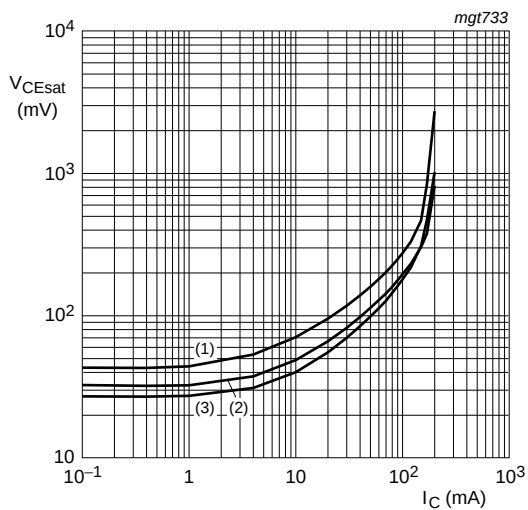
$V_{CE} = 5\text{ V}$   
(1)  $T_{amb} = 150\text{ }^{\circ}\text{C}$   
(2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$   
(3)  $T_{amb} = -55\text{ }^{\circ}\text{C}$

Fig 9. Group C: DC current gain as a function of collector current; typical values



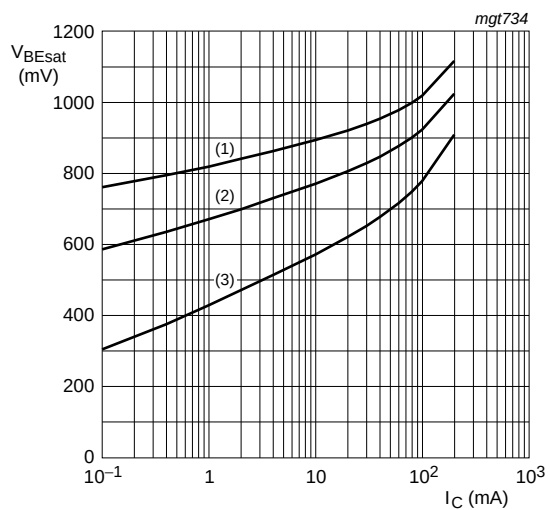
$V_{CE} = 5\text{ V}$   
(1)  $T_{amb} = -55\text{ }^{\circ}\text{C}$   
(2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$   
(3)  $T_{amb} = 150\text{ }^{\circ}\text{C}$

Fig 10. Group C: Base-emitter voltage as a function of collector current; typical values



$I_C/I_B = 20$   
(1)  $T_{amb} = 150\text{ }^{\circ}\text{C}$   
(2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$   
(3)  $T_{amb} = -55\text{ }^{\circ}\text{C}$

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



$I_C/I_B = 10$   
(1)  $T_{amb} = -55\text{ }^{\circ}\text{C}$   
(2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$   
(3)  $T_{amb} = 150\text{ }^{\circ}\text{C}$

Fig 12. Group C: Base-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

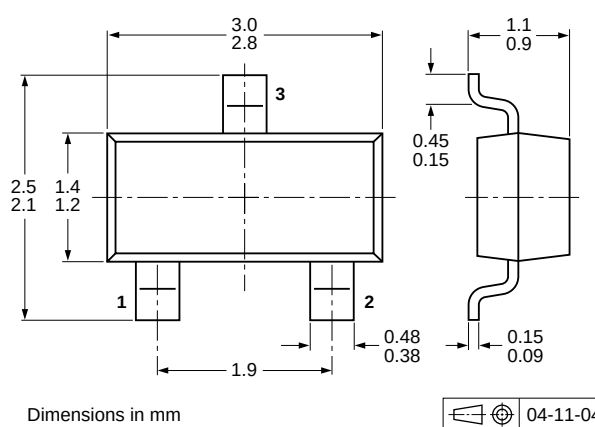


Fig 13. Package outline SOT23 (TO-236AB)

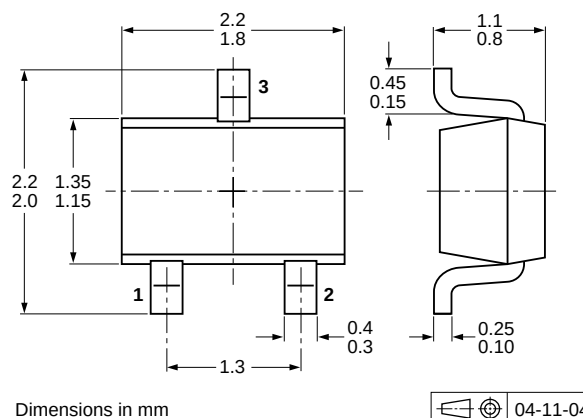


Fig 14. Package outline SOT323 (SC-70)

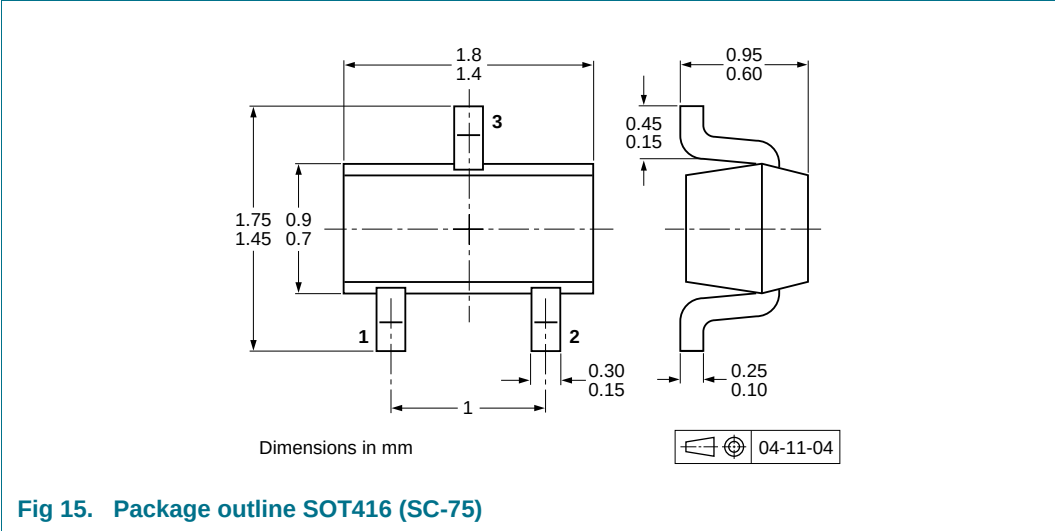


Fig 15. Package outline SOT416 (SC-75)

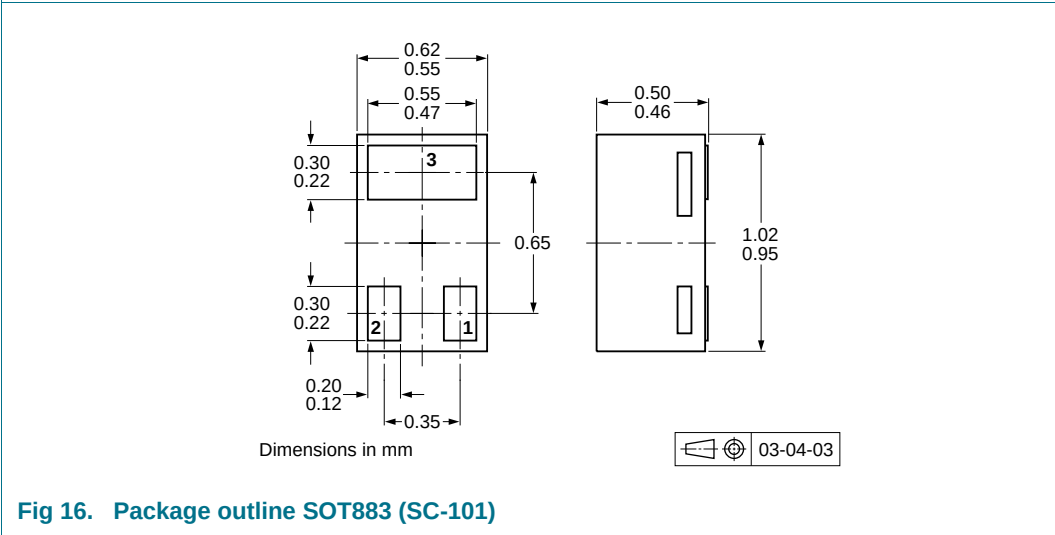


Fig 16. Package outline SOT883 (SC-101)

10. Soldering

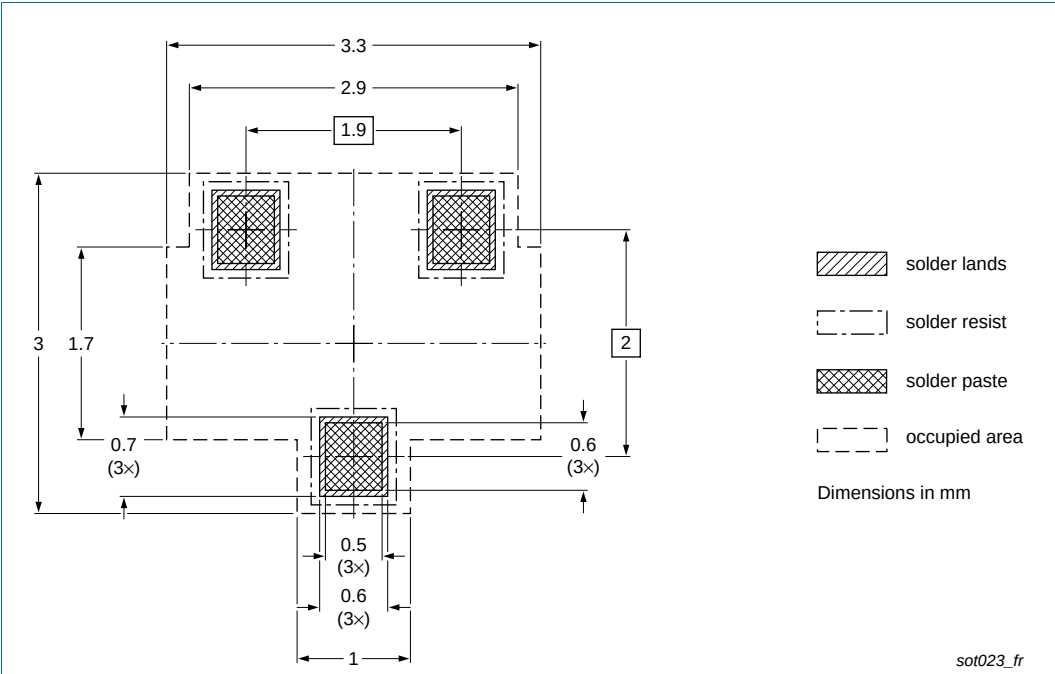


Fig 17. Reflow soldering footprint SOT23 (TO-236AB)

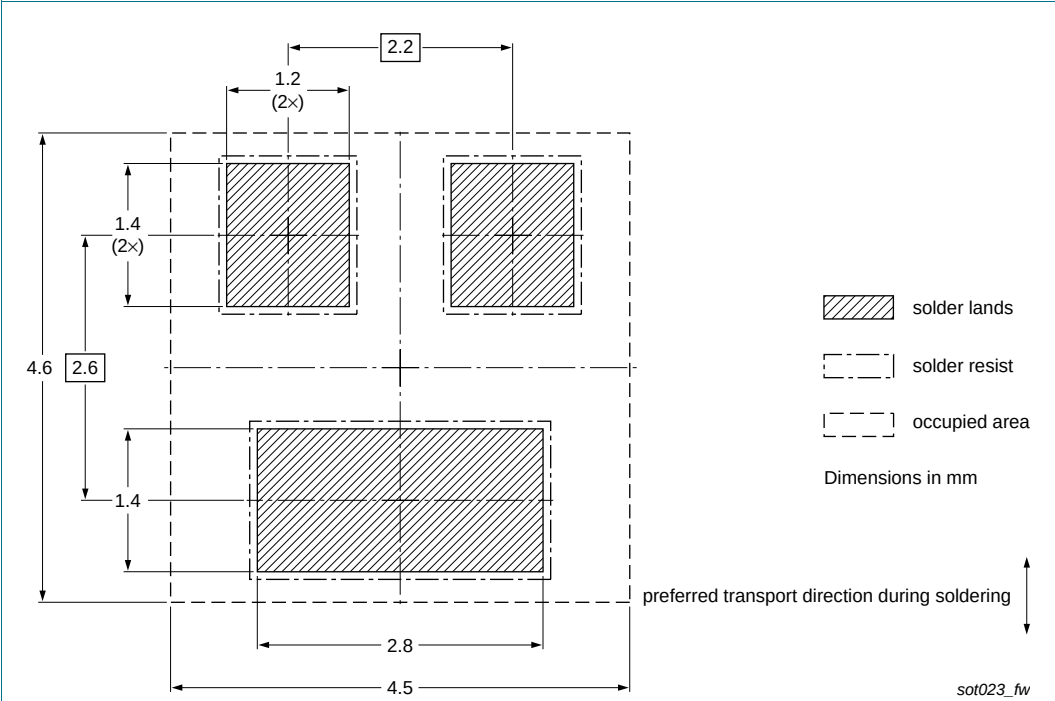


Fig 18. Wave soldering footprint SOT23 (TO-236AB)

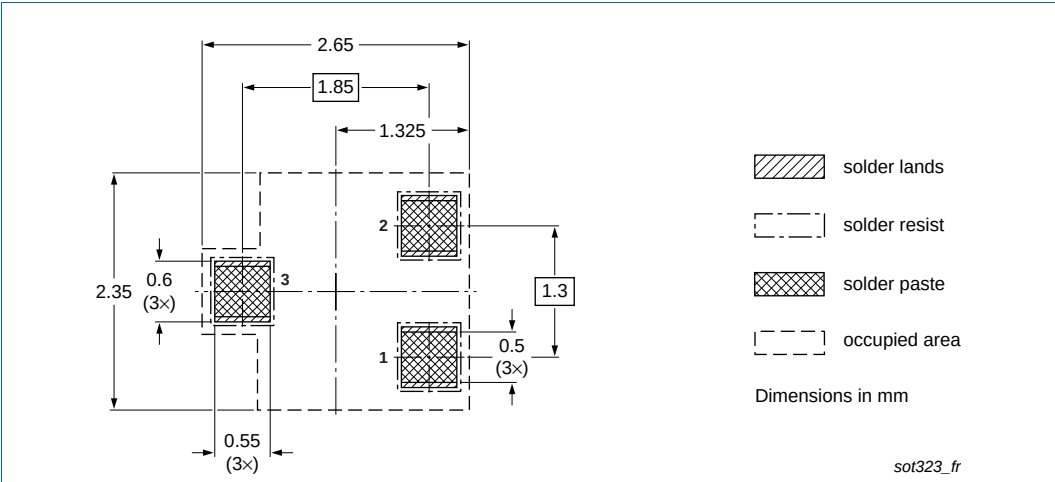


Fig 19. Reflow soldering footprint SOT323 (SC-70)

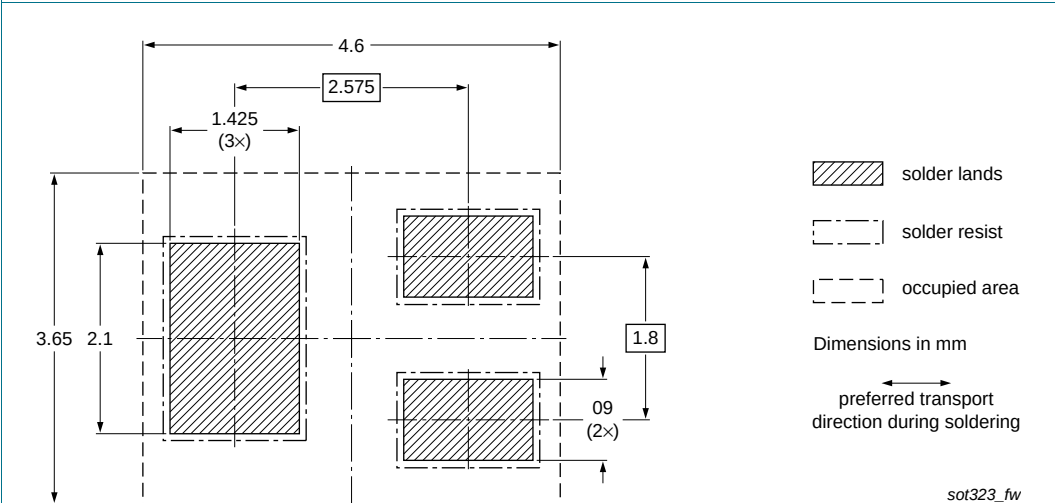


Fig 20. Wave soldering footprint SOT323 (SC-70)

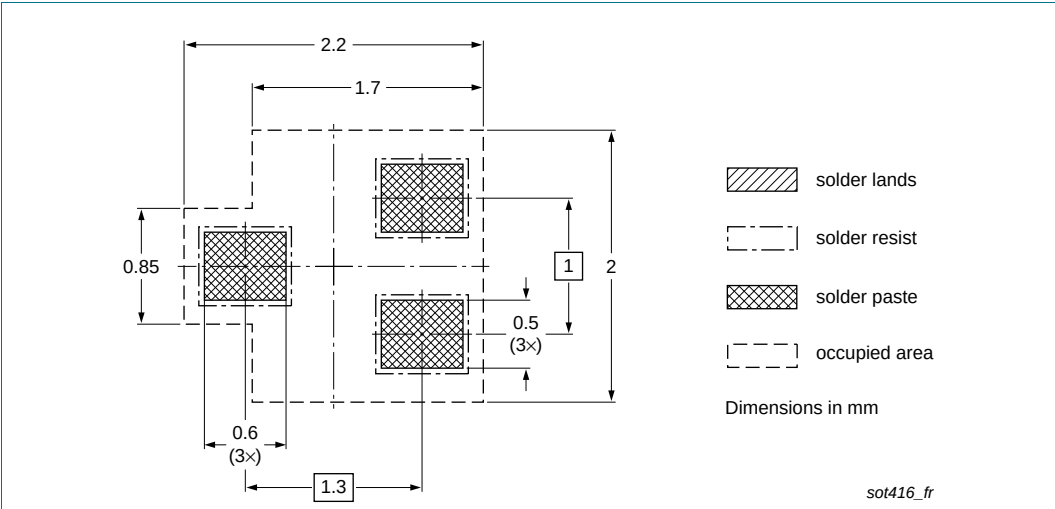


Fig 21. Reflow soldering footprint SOT416 (SC-75)

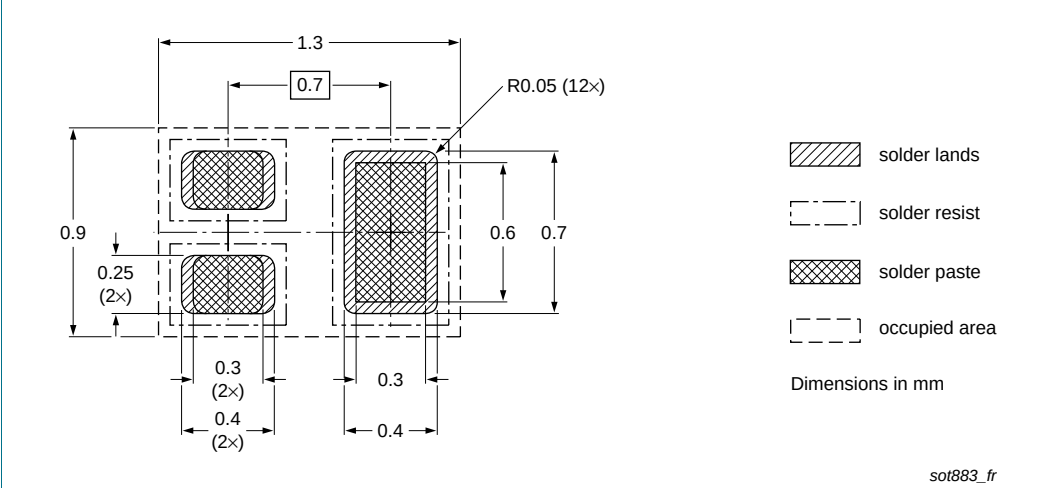


Fig 22. Reflow soldering footprint SOT883 (SC-101)

## 11. Revision history

Table 9. Revision history

| Document ID         | Release date                                                                                                                                                                                                                                                                                                                                                | Data sheet status  | Change notice | Supersedes          |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|---------------|---------------------|
| BC847_SER v.9       | 20140923                                                                                                                                                                                                                                                                                                                                                    | Product data sheet | -             | BC847_SER v.8       |
| Modifications:      | <ul style="list-style-type: none"><li>• <a href="#">Section 1.2 "Features and benefits"</a>: updated</li><li>• <a href="#">Section 5 "Limiting values"</a>: updated</li><li>• <a href="#">Figure 5</a>: corrected</li><li>• <a href="#">Section 8 "Test information"</a>: added</li><li>• <a href="#">Section 12 "Legal information"</a>: updated</li></ul> |                    |               |                     |
| BC847_SER v.8       | 20120820                                                                                                                                                                                                                                                                                                                                                    | Product data sheet | -             | BC847_BC547_SER v.7 |
| BC847_BC547_SER v.7 | 20081210                                                                                                                                                                                                                                                                                                                                                    | Product data sheet | -             | BC847_BC547_SER v.6 |
| BC847_BC547_SER v.6 | 20050519                                                                                                                                                                                                                                                                                                                                                    | Product data sheet | -             | -                   |

## 12. Legal information

### 12.1 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>.

### 12.2 Definitions

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