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# BC846 series

65 V, 100 mA NPN general-purpose transistors

Rev. 9 — 25 September 2012

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    |                |
| BC846                      | SOT23   | -     | TO-236AB | BC856          |
| BC846W                     | SOT323  | SC-70 | -        | BC856W         |
| BC846T                     | SOT416  | SC-75 | -        | BC856T         |

[1] Valid for all available selection groups.

### 1.2 Features and benefits

- General-purpose transistors
- SMD plastic packages
- Two different gain selections

### 1.3 Applications

- General-purpose switching and amplification

### 1.4 Quick reference data

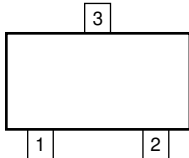
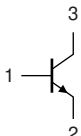
Table 2. Quick reference data

| Symbol    | Parameter                 | Conditions                               | Min | Typ | Max | Unit |
|-----------|---------------------------|------------------------------------------|-----|-----|-----|------|
| $V_{CE0}$ | collector-emitter voltage | open base                                | -   | -   | 65  | V    |
| $I_C$     | collector current         |                                          | -   | -   | 100 | mA   |
| $h_{FE}$  | DC current gain           | $V_{CE} = 5\text{ V}; I_C = 2\text{ mA}$ | 110 | -   | 450 |      |
|           | $h_{FE}$ group A          |                                          | 110 | 180 | 220 |      |
|           | $h_{FE}$ group B          |                                          | 200 | 290 | 450 |      |



## 2. Pinning information

Table 3. Pinning

| Pin                          | Description | Simplified outline                                                                               | Graphic symbol                                                                                |
|------------------------------|-------------|--------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| <b>SOT23, SOT323, SOT416</b> |             |                                                                                                  |                                                                                               |
| 1                            | base        | <br>006aaa144 | <br>sym021 |
| 2                            | emitter     |                                                                                                  |                                                                                               |
| 3                            | collector   |                                                                                                  |                                                                                               |

## 3. Ordering information

Table 4. Ordering information

| Type number <sup>[1]</sup> | Package |                                          |         |
|----------------------------|---------|------------------------------------------|---------|
|                            | Name    | Description                              | Version |
| BC846                      | -       | plastic surface-mounted package; 3 leads | SOT23   |
| BC846W                     | SC-70   | plastic surface-mounted package; 3 leads | SOT323  |
| BC846T                     | SC-75   | plastic surface-mounted package; 3 leads | SOT416  |

[1] Valid for all available selection groups.

## 4. Marking

Table 5. Marking codes

| Type number | Marking code <sup>[1]</sup> |
|-------------|-----------------------------|
| BC846       | 1D*                         |
| BC846A      | 1A*                         |
| BC846B      | 1B*                         |
| BC846W      | 1D*                         |
| BC846AW     | 1A*                         |
| BC846BW     | 1B*                         |
| BC846T      | 1M                          |
| BC846AT     | 1A                          |
| BC846BT     | 1B                          |

[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                     | -   | 80   | V    |
| $V_{CEO}$ | collector-emitter voltage | open base                        | -   | 65   | 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 | -   | 200  | mA   |
| $P_{tot}$ | total power dissipation   | $T_{amb} \leq 25$ °C             | [1] |      |      |
|           | SOT23                     |                                  | -   | 250  | mW   |
|           | SOT323                    |                                  | -   | 200  | mW   |
|           | SOT416                    |                                  | -   | 150  | 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.

## 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  |

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

## 7. Characteristics

**Table 8. Characteristics**

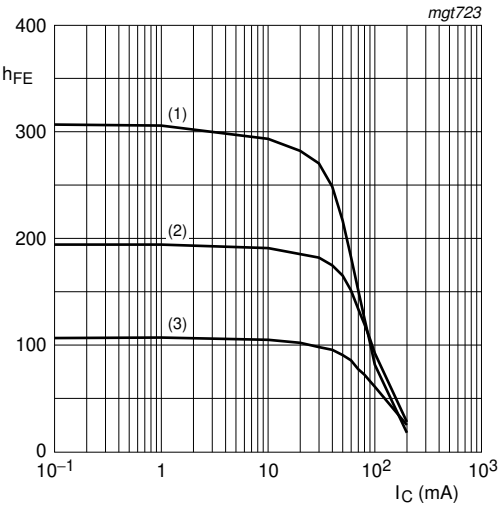
$T_{amb} = 25\text{ }^{\circ}\text{C}$  unless otherwise specified.

| Symbol      | Parameter                            | Conditions                                                                                                       | Min     | Typ | Max | Unit          |
|-------------|--------------------------------------|------------------------------------------------------------------------------------------------------------------|---------|-----|-----|---------------|
| $I_{CBO}$   | collector-base cut-off current       | $V_{CB} = 30\text{ V}; I_E = 0\text{ A}$                                                                         | -       | -   | 15  | nA            |
|             |                                      | $V_{CB} = 30\text{ V}; I_E = 0\text{ A}; T_j = 150\text{ }^{\circ}\text{C}$                                      | -       | -   | 5   | $\mu\text{A}$ |
| $I_{EBO}$   | emitter-base cut-off current         | $V_{EB} = 5\text{ V}; I_C = 0\text{ A}$                                                                          | -       | -   | 100 | nA            |
| $h_{FE}$    | DC current gain                      | $V_{CE} = 5\text{ V}; I_C = 10\text{ }\mu\text{A}$                                                               |         |     |     |               |
|             | $h_{FE}$ group A                     |                                                                                                                  | -       | 180 | -   |               |
|             | $h_{FE}$ group B                     |                                                                                                                  | -       | 290 | -   |               |
|             | DC current gain                      | $V_{CE} = 5\text{ V}; I_C = 2\text{ mA}$                                                                         | 110     | -   | 450 |               |
|             | $h_{FE}$ group A                     |                                                                                                                  | 110     | 180 | 220 |               |
|             | $h_{FE}$ group B                     |                                                                                                                  | 200     | 290 | 450 |               |
| $V_{CEsat}$ | collector-emitter saturation voltage | $I_C = 10\text{ mA}; I_B = 0.5\text{ mA}$                                                                        | -       | 90  | 200 | mV            |
|             |                                      | $I_C = 100\text{ mA}; I_B = 5\text{ mA}$                                                                         | [1] -   | 200 | 400 | mV            |
| $V_{BEsat}$ | base-emitter saturation voltage      | $I_C = 10\text{ mA}; I_B = 0.5\text{ mA}$                                                                        | [2] -   | 760 | -   | mV            |
|             |                                      | $I_C = 100\text{ mA}; I_B = 5\text{ mA}$                                                                         | [2] -   | 900 | -   | mV            |
| $V_{BE}$    | base-emitter voltage                 | $I_C = 2\text{ mA}; V_{CE} = 5\text{ V}$                                                                         | [3] 580 | 660 | 700 | mV            |
|             |                                      | $I_C = 10\text{ mA}; V_{CE} = 5\text{ V}$                                                                        | [3] -   | -   | 770 | mV            |
| $f_T$       | transition frequency                 | $V_{CE} = 5\text{ V}; I_C = 10\text{ mA}; f = 100\text{ MHz}$                                                    | 100     | -   | -   | MHz           |
| $C_c$       | collector capacitance                | $V_{CB} = 10\text{ V}; I_E = I_E = 0\text{ A}; f = 1\text{ MHz}$                                                 | -       | 2   | 3   | pF            |
| $C_e$       | emitter capacitance                  | $V_{EB} = 0.5\text{ V}; I_C = I_C = 0\text{ A}; f = 1\text{ MHz}$                                                | -       | 11  | -   | pF            |
| NF          | noise figure                         | $I_C = 200\text{ }\mu\text{A}; V_{CE} = 5\text{ V}; R_S = 2\text{ k}\Omega; f = 1\text{ kHz}; B = 200\text{ Hz}$ | -       | 2   | 10  | dB            |

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

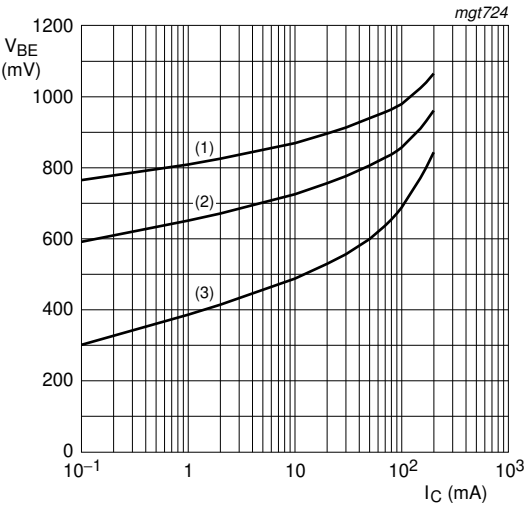
[2]  $V_{BEsat}$  decreases by approximately 1.7 mV/K with increasing temperature.

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



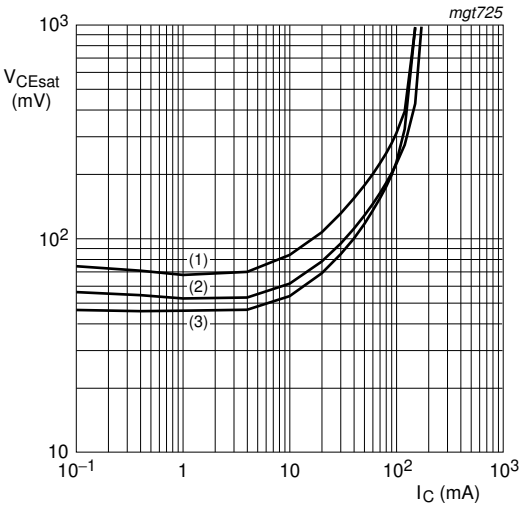
- $V_{CE} = 5\text{ V}$
- (1)  $T_{amb} = 150\text{ }^{\circ}\text{C}$
  - (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$
  - (3)  $T_{amb} = -55\text{ }^{\circ}\text{C}$

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



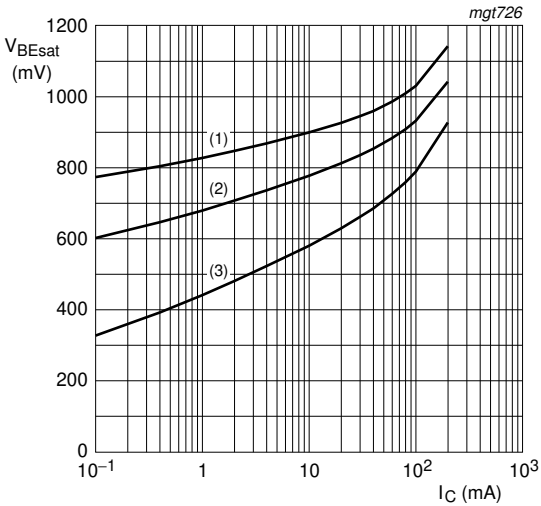
- $V_{CE} = 5\text{ V}$
- (1)  $T_{amb} = -55\text{ }^{\circ}\text{C}$
  - (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$
  - (3)  $T_{amb} = 150\text{ }^{\circ}\text{C}$

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



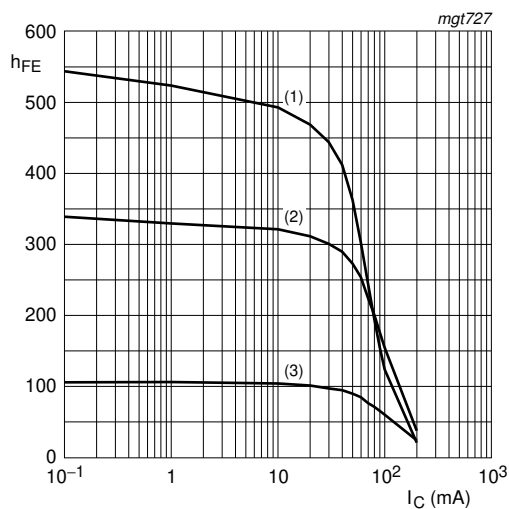
- $I_C/I_B = 20$
- (1)  $T_{amb} = 150\text{ }^{\circ}\text{C}$
  - (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$
  - (3)  $T_{amb} = -55\text{ }^{\circ}\text{C}$

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



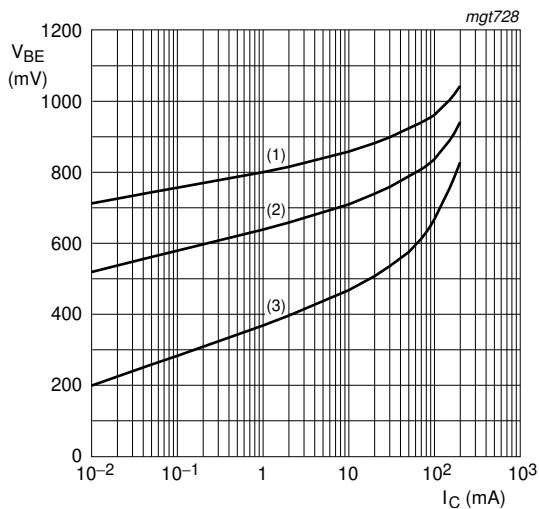
- $I_C/I_B = 10$
- (1)  $T_{amb} = -55\text{ }^{\circ}\text{C}$
  - (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$
  - (3)  $T_{amb} = 150\text{ }^{\circ}\text{C}$

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



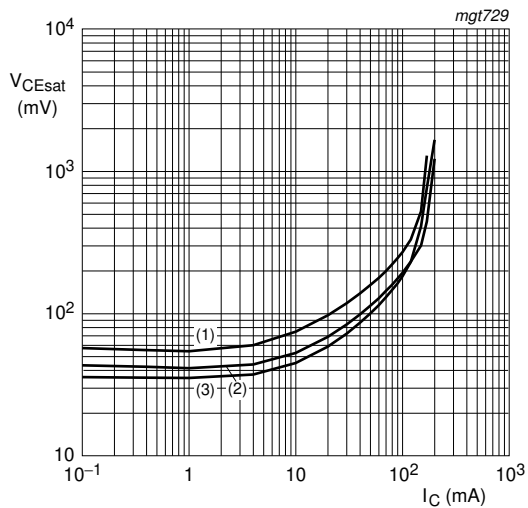
$V_{CE} = 5\text{ V}$   
(1)  $T_{amb} = 150\text{ }^{\circ}\text{C}$   
(2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$   
(3)  $T_{amb} = -55\text{ }^{\circ}\text{C}$

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



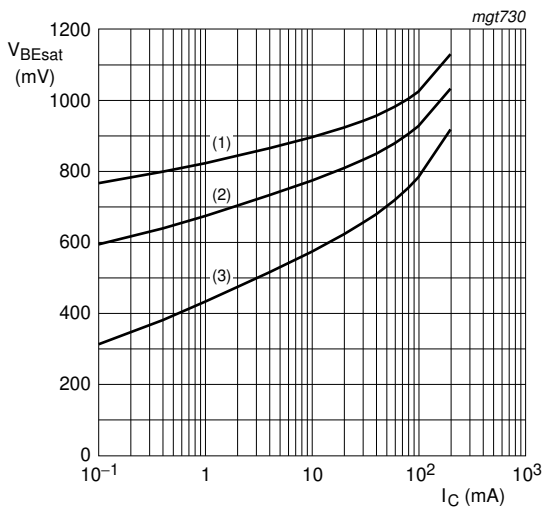
$V_{CE} = 5\text{ V}$   
(1)  $T_{amb} = -55\text{ }^{\circ}\text{C}$   
(2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$   
(3)  $T_{amb} = 150\text{ }^{\circ}\text{C}$

Fig 6. Selection 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)  $T_{amb} = -55\text{ }^{\circ}\text{C}$

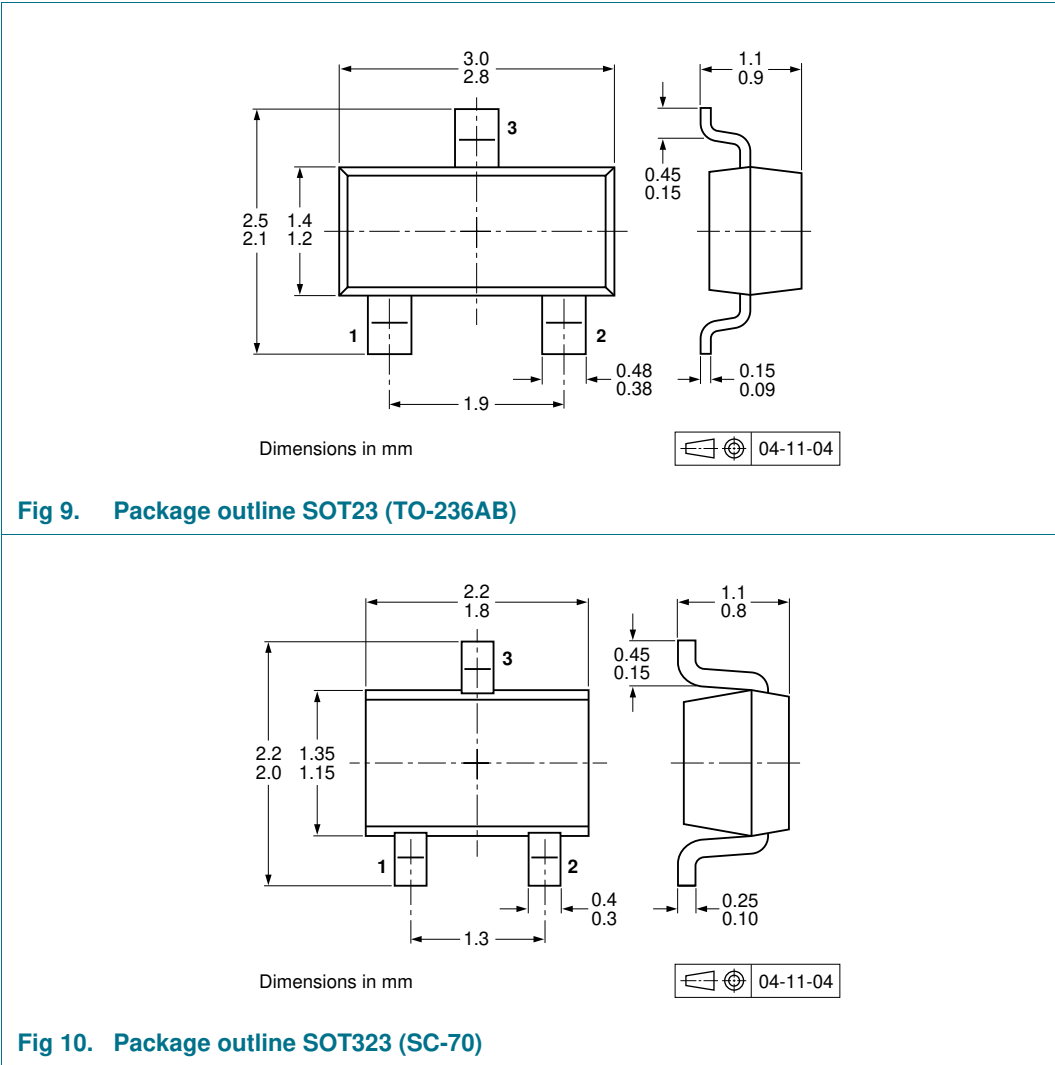
Fig 7. Selection B: Collector-emitter saturation voltage as a function of collector current; typical values

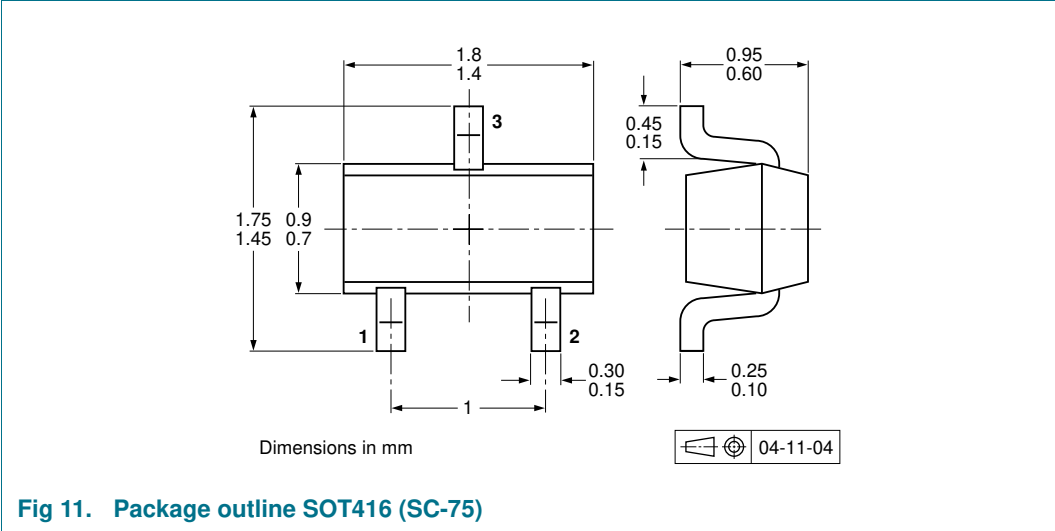


$I_C/I_B = 10$   
(1)  $T_{amb} = -55\text{ }^{\circ}\text{C}$   
(2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$   
(3)  $T_{amb} = 150\text{ }^{\circ}\text{C}$

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

8. Package outline





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             | 3000 | 4000 |
| BC846                      | SOT23   | 4 mm pitch, 8 mm tape and reel | -215             | -    | -235 |
| BC846W                     | SOT323  | 4 mm pitch, 8 mm tape and reel | -115             | -    | -135 |
| BC846T                     | SOT416  | 4 mm pitch, 8 mm tape and reel | -115             | -    | -135 |

[1] For further information and the availability of packing methods, see [Section 13](#).  
[2] Valid for all available selection groups.

10. Soldering

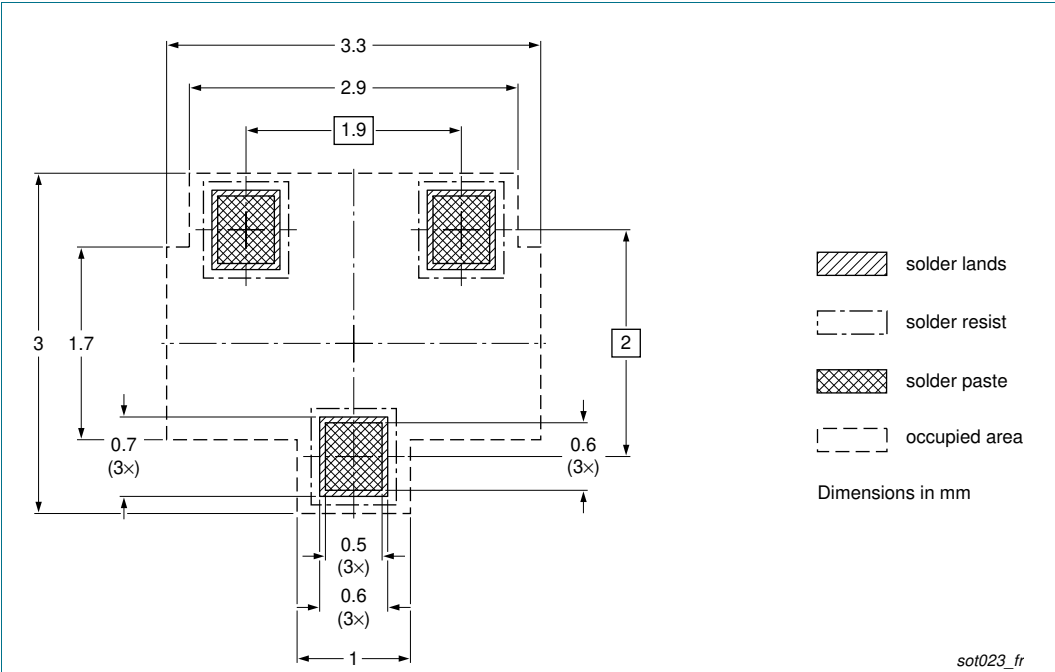


Fig 12. Reflow soldering footprint SOT23 (TO-236AB)

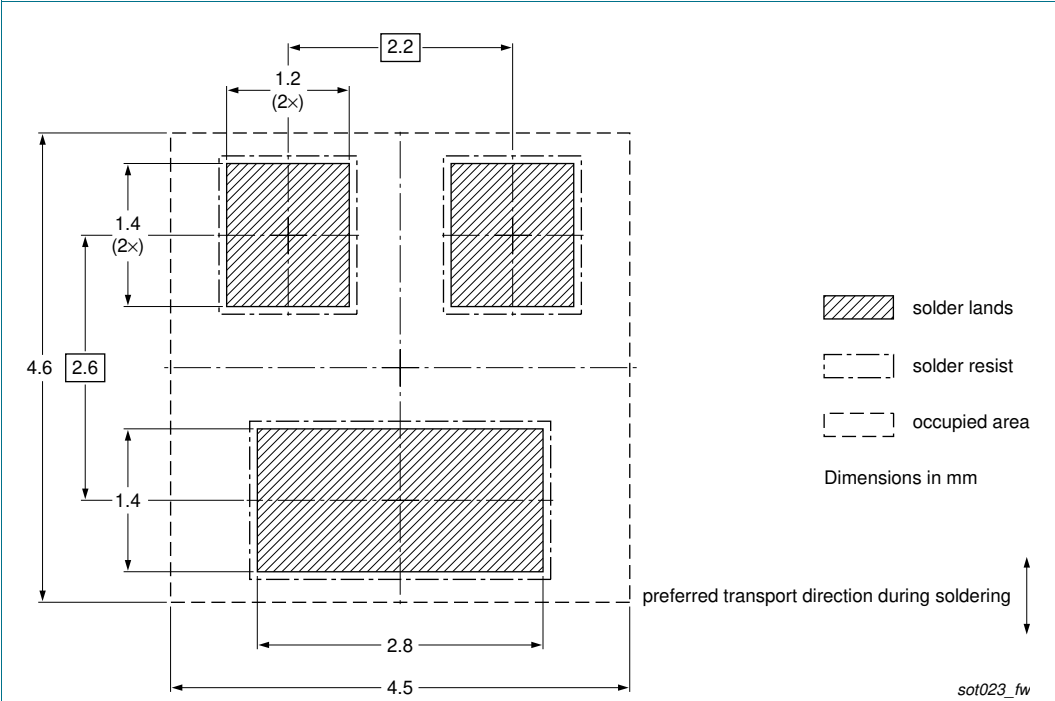


Fig 13. Wave soldering footprint SOT23 (TO-236AB)

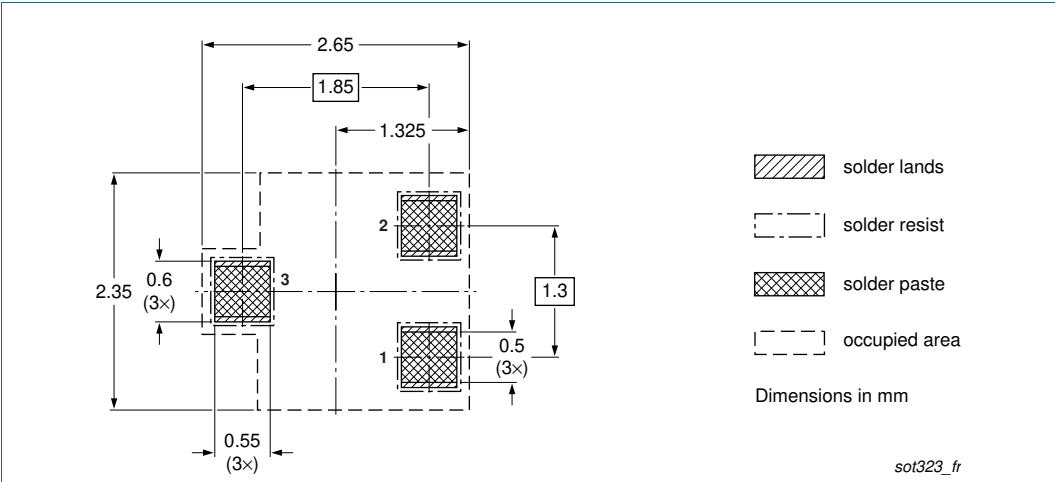


Fig 14. Reflow soldering footprint SOT323 (SC-70)

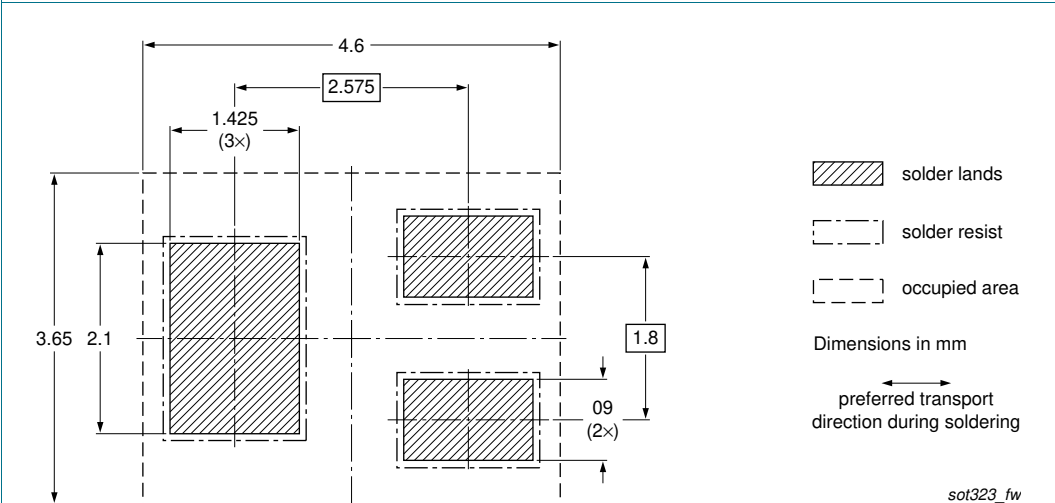


Fig 15. Wave soldering footprint SOT323 (SC-70)



## 11. Revision history

**Table 10. Revision history**

| Document ID         | Release date                                                             | Data sheet status  | Change notice | Supersedes          |
|---------------------|--------------------------------------------------------------------------|--------------------|---------------|---------------------|
| BC846_SER v.9       | 20120925                                                                 | Product data sheet | -             | BC846_SER v.8       |
| Modifications:      | • <a href="#">Table 6 "Limiting values"</a> : $P_{tot}$ values corrected |                    |               |                     |
| BC846_SER v.8       | 20120424                                                                 | Product data sheet |               | BC846_BC546_SER v.7 |
| BC846_BC546_SER v.7 | 20091117                                                                 | Product data sheet | -             | BC846_BC546_SER v.6 |
| BC846_BC546_SER v.6 | 20060207                                                                 | 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>.

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## 14. Contents

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|           |                                          |           |
|-----------|------------------------------------------|-----------|
| <b>1</b>  | <b>Product profile</b> . . . . .         | <b>1</b>  |
| 1.1       | General description . . . . .            | 1         |
| 1.2       | Features and benefits . . . . .          | 1         |
| 1.3       | Applications . . . . .                   | 1         |
| 1.4       | Quick reference data . . . . .           | 1         |
| <b>2</b>  | <b>Pinning information</b> . . . . .     | <b>2</b>  |
| <b>3</b>  | <b>Ordering information</b> . . . . .    | <b>2</b>  |
| <b>4</b>  | <b>Marking</b> . . . . .                 | <b>2</b>  |
| <b>5</b>  | <b>Limiting values</b> . . . . .         | <b>3</b>  |
| <b>6</b>  | <b>Thermal characteristics</b> . . . . . | <b>3</b>  |
| <b>7</b>  | <b>Characteristics</b> . . . . .         | <b>4</b>  |
| <b>8</b>  | <b>Package outline</b> . . . . .         | <b>7</b>  |
| <b>9</b>  | <b>Packing information</b> . . . . .     | <b>8</b>  |
| <b>10</b> | <b>Soldering</b> . . . . .               | <b>9</b>  |
| <b>11</b> | <b>Revision history</b> . . . . .        | <b>12</b> |
| <b>12</b> | <b>Legal information</b> . . . . .       | <b>13</b> |
| 12.1      | Data sheet status . . . . .              | 13        |
| 12.2      | Definitions . . . . .                    | 13        |
| 12.3      | Disclaimers . . . . .                    | 13        |
| 12.4      | Trademarks . . . . .                     | 14        |
| <b>13</b> | <b>Contact information</b> . . . . .     | <b>14</b> |
| <b>14</b> | <b>Contents</b> . . . . .                | <b>15</b> |

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