

# BCP54; BCX54; BC54PA

45 V, 1 A NPN medium power transistors

Rev. 8 — 21 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	
BCP54	SOT223	SC-73	-	BCP51
BCX54	SOT89	SC-62	TO-243	BCX51
BC54PA	SOT1061	-	-	BC51PA

[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

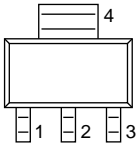
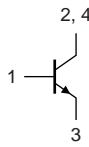
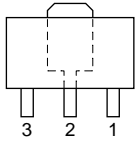
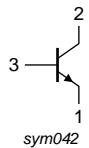
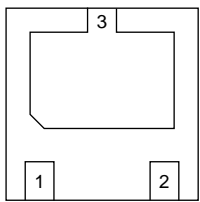
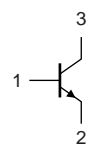
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CE0}$	collector-emitter voltage	open base	-	-	45	V
$I_C$	collector current		-	-	1	A
$I_{CM}$	peak collector current	single pulse; $t_p \leq 1$ ms	-	-	2	A
$h_{FE}$	DC current gain	$V_{CE} = 2$ V; $I_C = 150$ mA	[1] 63	-	250	
	$h_{FE}$ selection -10	$V_{CE} = 2$ V; $I_C = 150$ mA	[1] 63	-	160	
	$h_{FE}$ selection -16	$V_{CE} = 2$ V; $I_C = 150$ mA	[1] 100	-	250	

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

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## 2. Pinning information

Table 3. Pinning

Pin	Description	Simplified outline	Graphic symbol
<b>SOT223</b>			
1	base		
2	collector		
3	emitter		
4	collector		
<b>SOT89</b>			
1	emitter		
2	collector		
3	base		
<b>SOT1061</b>			
1	base	 <p>Transparent top view</p>	
2	emitter		
3	collector		

## 3. Ordering information

Table 4. Ordering information

Type number <sup>[1]</sup>	Package		
	Name	Description	Version
BCP54	SC-73	plastic surface-mounted package with increased heatsink; 4 leads	SOT223
BCX54	SC-62	plastic surface-mounted package; exposed die pad for good heat transfer; 3 leads	SOT89
BC54PA	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
BCP54	BCP54
BCP54-10	BCP54/10
BCP54-16	BCP54/16
BCX54	BA
BCX54-10	BC
BCX54-16	BD
BC54PA	AT
BC54-10PA	BF
BC54-16PA	BG

## 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; $t_p \leq 1$ ms	-	2	A			
$I_B$	base current		-	0.3	A			
$I_{BM}$	peak base current	single pulse; $t_p \leq 1$ ms	-	0.3	A			
$P_{tot}$	total power dissipation	$T_{amb} \leq 25$ °C						
			BCP54	[1]	-	0.65	W	
				[2]	-	1.00	W	
				[3]	-	1.35	W	
			BCX54	[1]	-	0.50	W	
				[2]	-	0.95	W	
				[3]	-	1.35	W	
			BC54PA	[1]	-	0.42	W	
				[2]	-	0.83	W	
				[3]	-	1.10	W	
				[4]	-	0.81	W	
				[5]	-	1.65	W	
			$T_j$	junction temperature		-	150	°C
			$T_{amb}$	ambient temperature		-55	+150	°C
			$T_{stg}$	storage temperature		-65	+150	°C

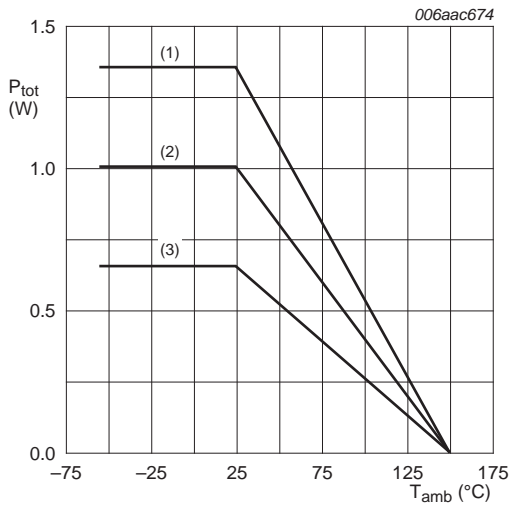
[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and standard footprint.

[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>.

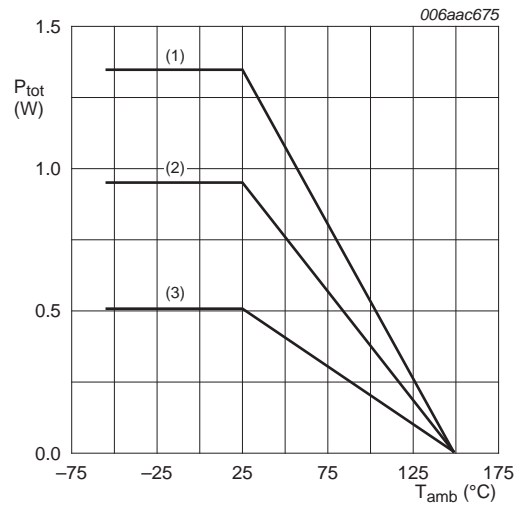
[4] Device mounted on an FR4 PCB, 4-layer copper, tin-plated and standard footprint.

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



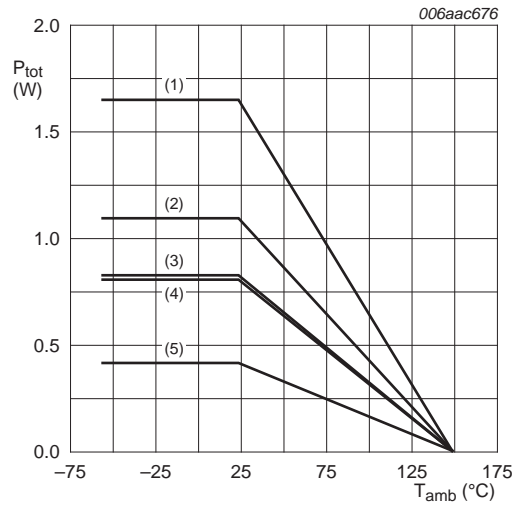
- (1) FR4 PCB, mounting pad for collector 6 cm<sup>2</sup>
- (2) FR4 PCB, mounting pad for collector 1 cm<sup>2</sup>
- (3) FR4 PCB, standard footprint

**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	BCP54	[1]	-	-	192	K/W					
				[2]	-	-	125	K/W					
				[3]	-	-	93	K/W					
			BCX54	[1]	-	-	250	K/W					
				[2]	-	-	132	K/W					
				[3]	-	-	93	K/W					
			BC54PA	[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											
									BCP54	-	-	16	K/W
									BCX54	-	-	16	K/W
									BC54PA	-	-	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>.

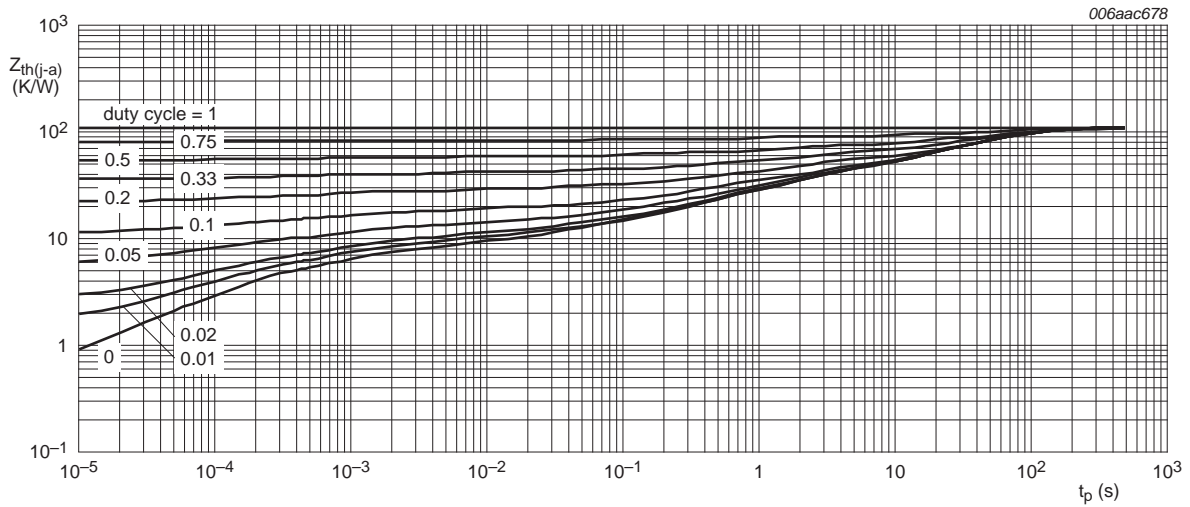
[3] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 6 cm<sup>2</sup>.

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

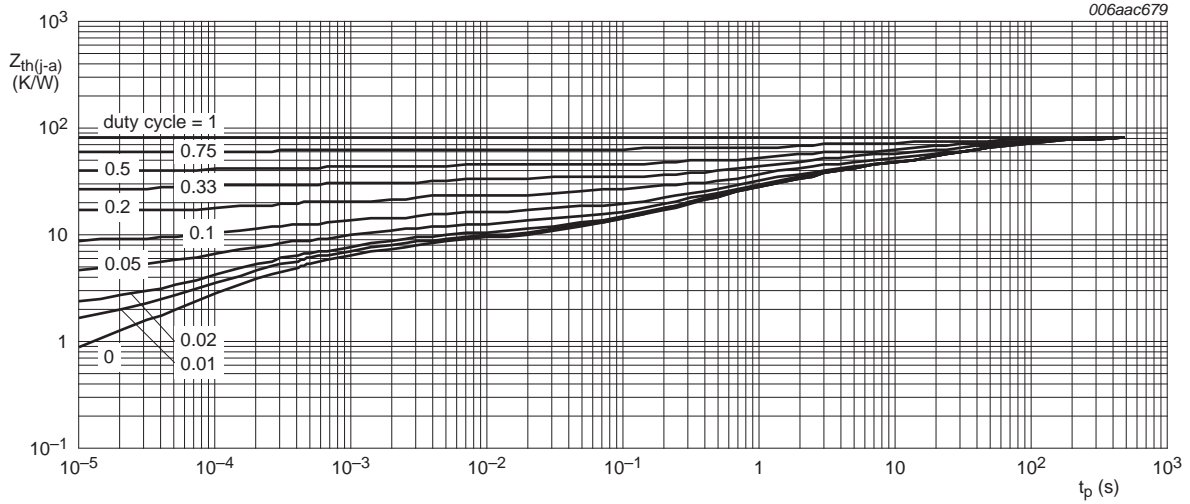
[5] Device mounted on an FR4 PCB, 4-layer copper, tin-plated, mounting pad for collector 1 cm<sup>2</sup>.



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



**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>

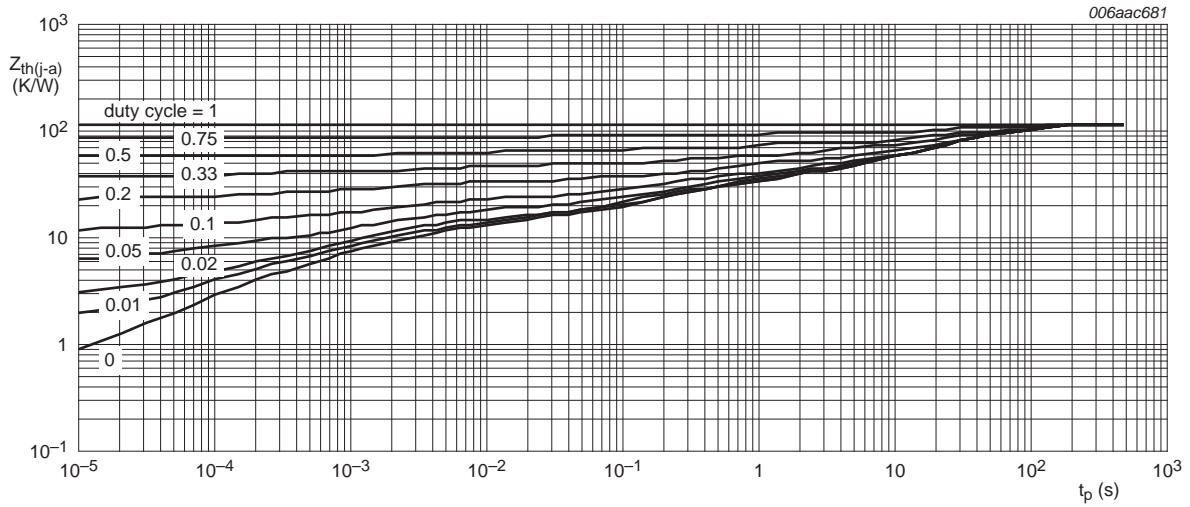
**Fig 6. Transient thermal impedance from junction to ambient as a function of pulse duration for SOT223; typical values**



FR4 PCB, standard footprint

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





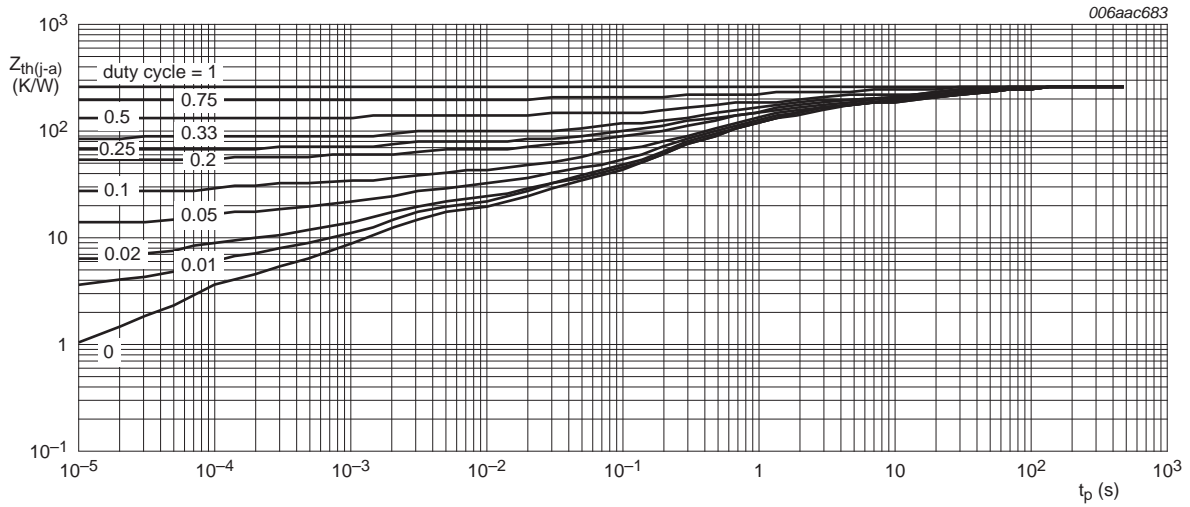
FR4 PCB, mounting pad for collector 1 cm<sup>2</sup>

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

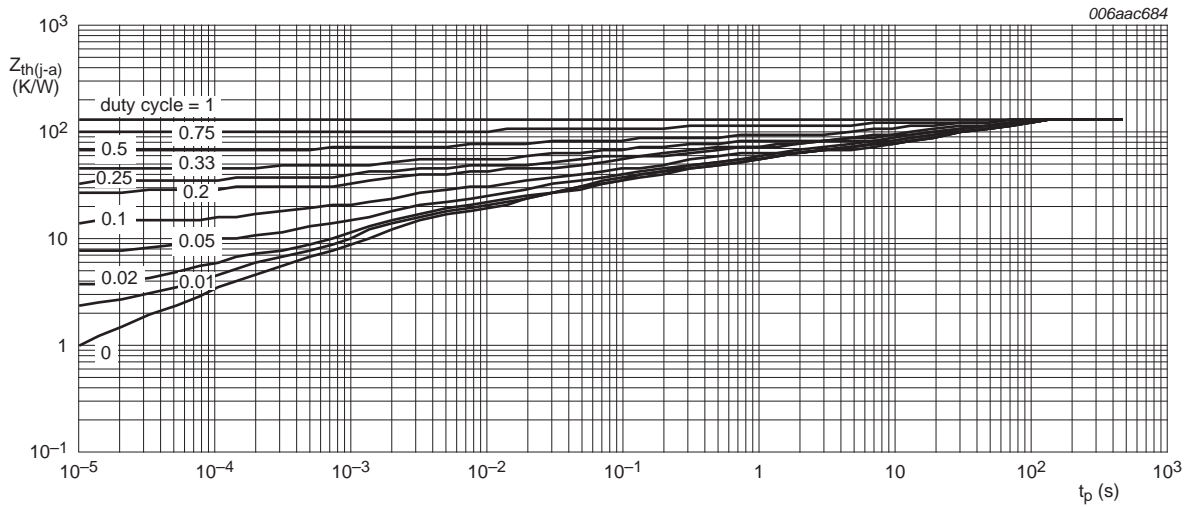


FR4 PCB, mounting pad for collector 6 cm<sup>2</sup>

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



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



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



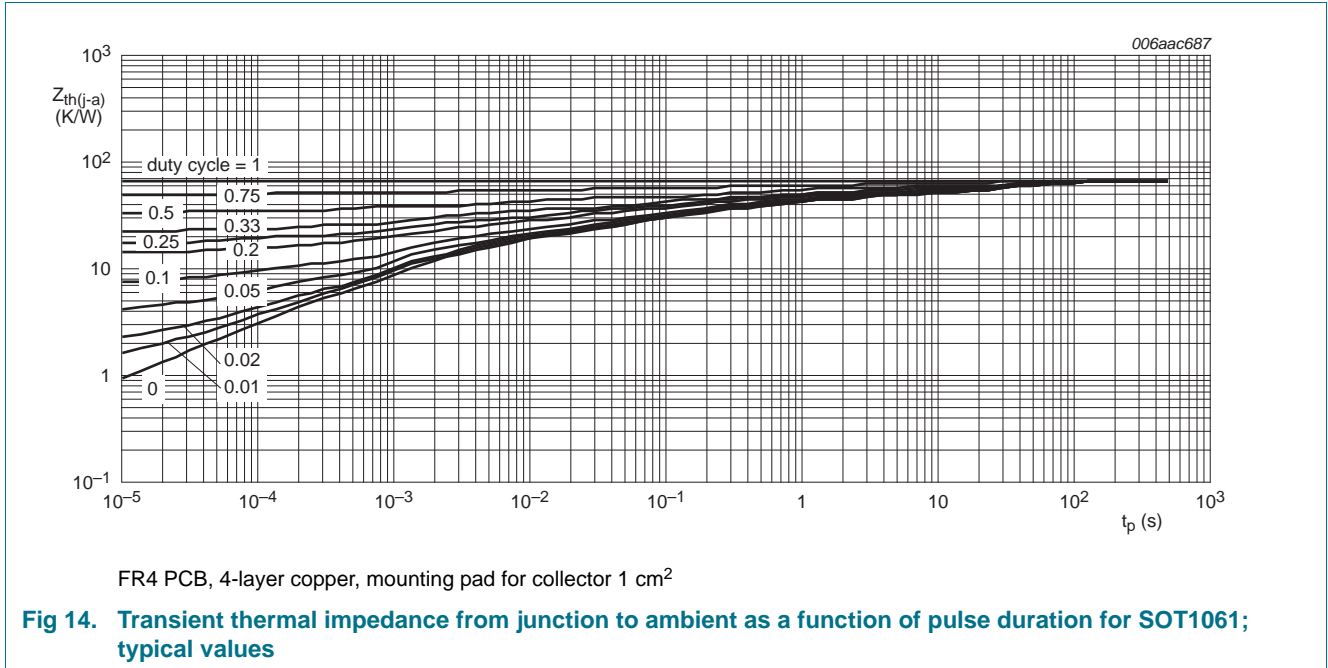
FR4 PCB, single-sided copper, mounting pad for collector 6 cm<sup>2</sup>

**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**

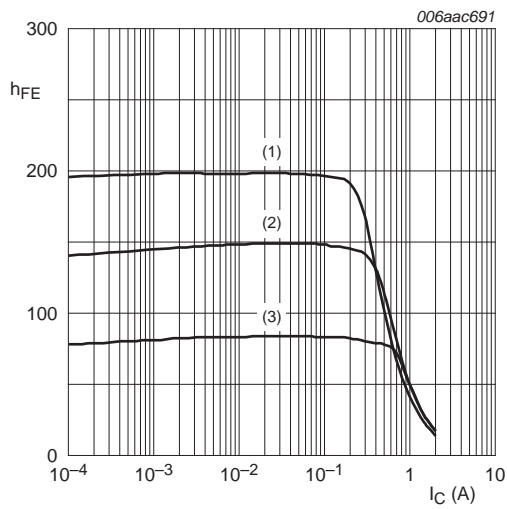


## 7. Characteristics

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

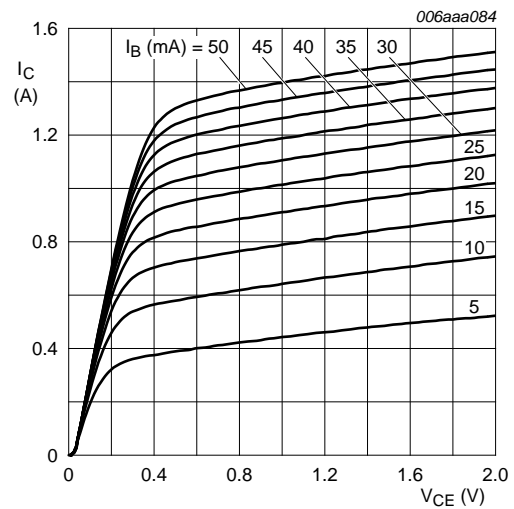
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I <sub>CBO</sub>	collector-base cut-off current	V <sub>CB</sub> = 30 V; I <sub>E</sub> = 0 A	-	-	100	nA
		V <sub>CB</sub> = 30 V; I <sub>E</sub> = 0 A; T <sub>j</sub> = 150 °C	-	-	10	μA
I <sub>EBO</sub>	emitter-base cut-off current	V <sub>EB</sub> = 5 V; I <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	[1] 63	-	-	
		I <sub>C</sub> = 150 mA	[1] 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	[1] 63	-	160	
h <sub>FE</sub> selection -16		I <sub>C</sub> = 150 mA	[1] 100	-	250	
V <sub>CEsat</sub>	collector-emitter saturation voltage	I <sub>C</sub> = 500 mA; I <sub>B</sub> = 50 mA	[1] -	-	0.5	V
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.



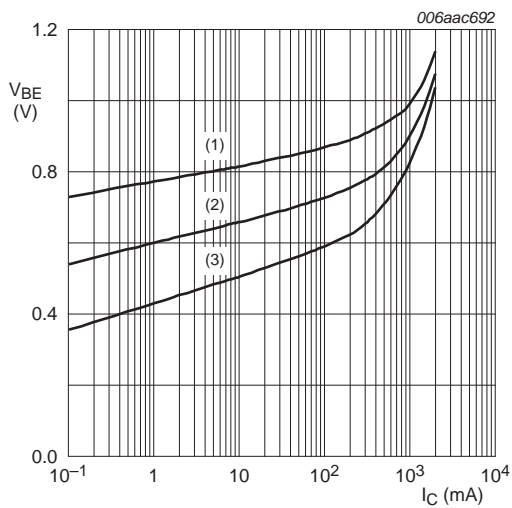
$V_{CE} = 2\text{ V}$   
 (1)  $T_{amb} = 100^\circ\text{C}$   
 (2)  $T_{amb} = 25^\circ\text{C}$   
 (3)  $T_{amb} = -55^\circ\text{C}$

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



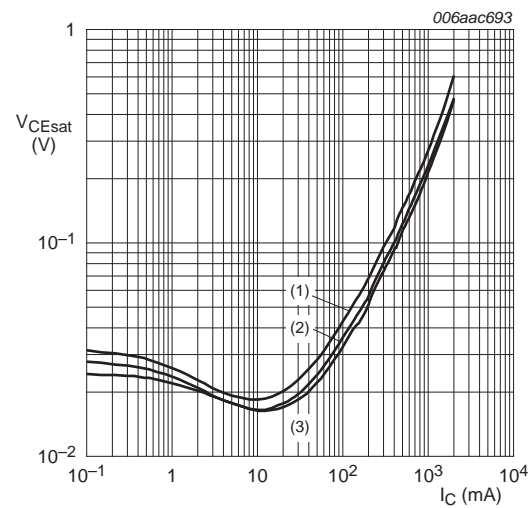
$T_{amb} = 25^\circ\text{C}$

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



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

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



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

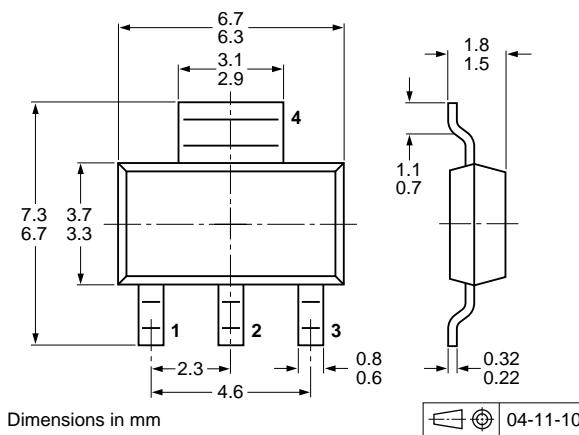
**Fig 18. Collector-emitter saturation voltage as a function of collector current; typical values**

## 8. Test information

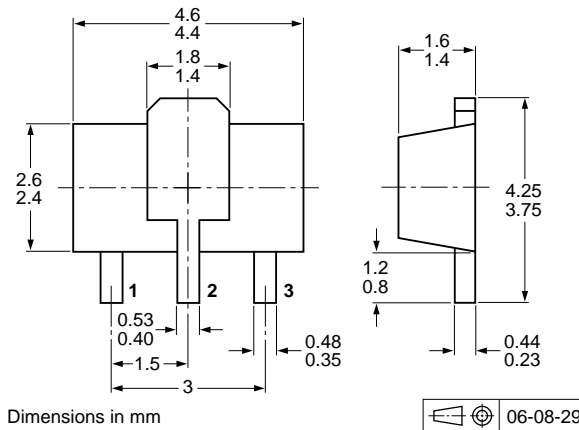
### 8.1 Quality information

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)**

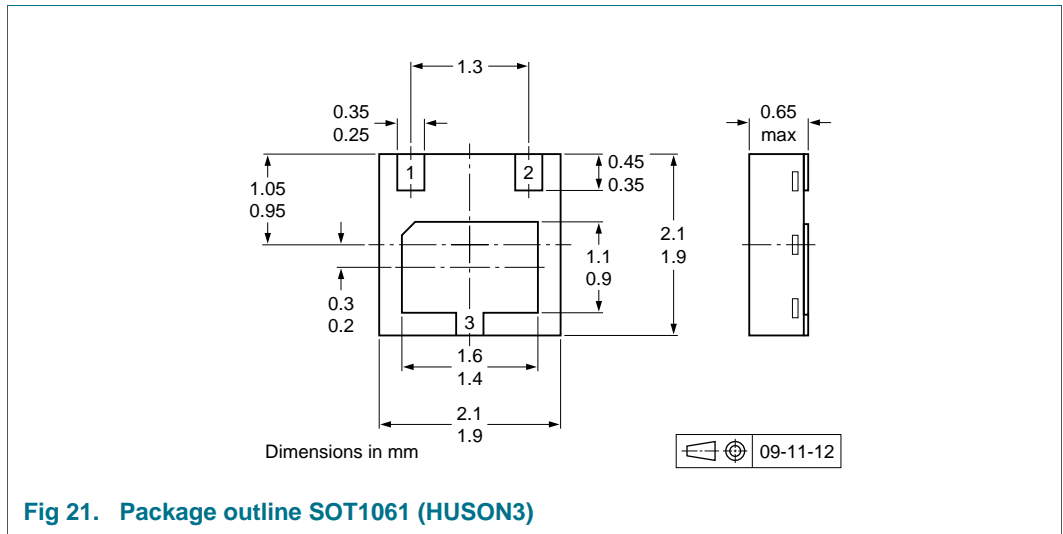


Fig 21. Package outline SOT1061 (HUSON3)

## 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
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>	-146	-	-
BC54PA	SOT1061	4 mm pitch, 8 mm tape and reel	-	-115	-

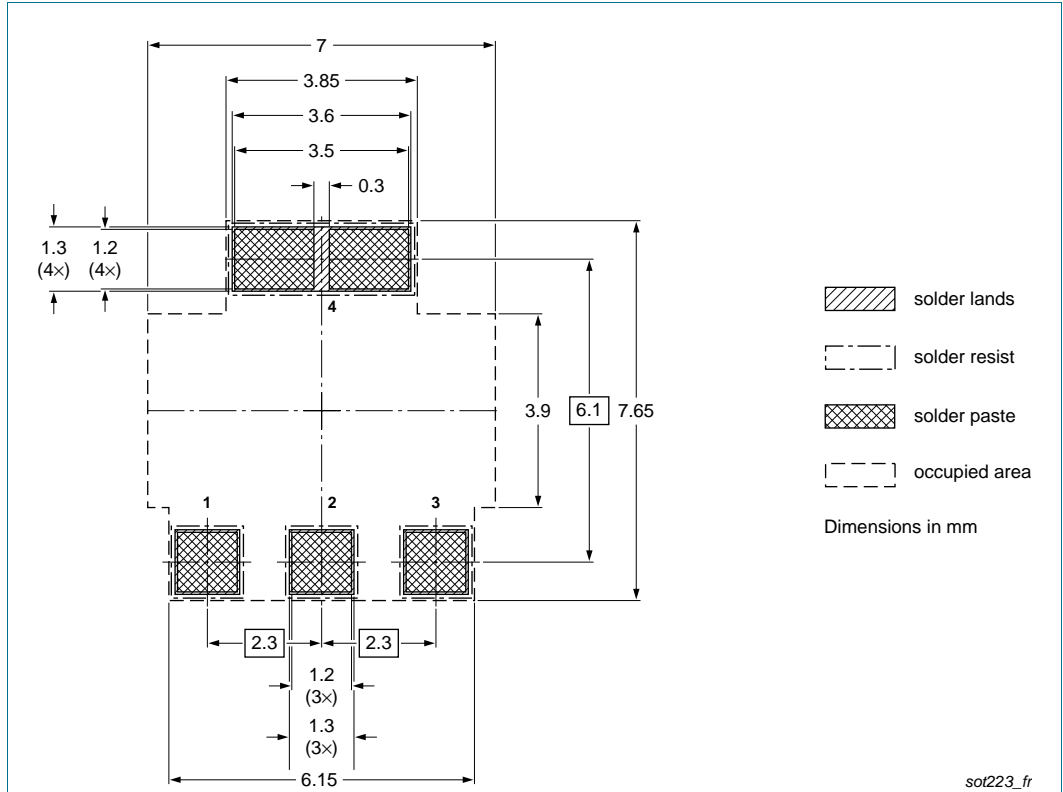
[1] For further information and the availability of packing methods, see [Section 14](#).

[2] Valid for all available selection groups.

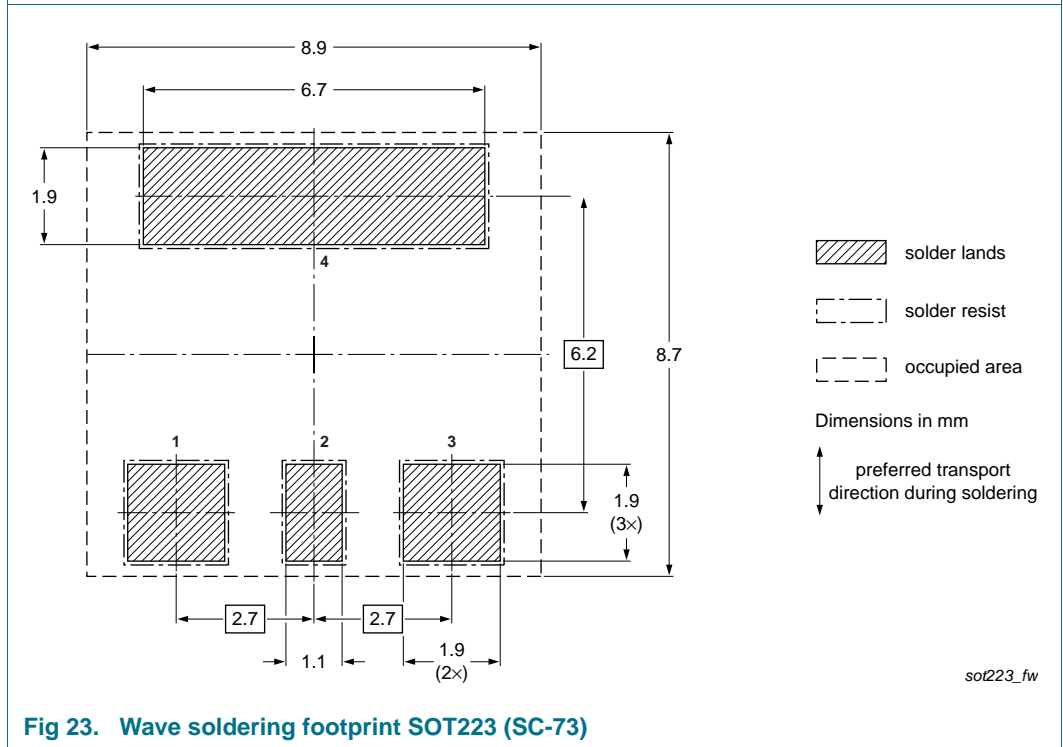
[3] T1: normal taping

[4] T3: 90° rotated taping

**11. Soldering**



**Fig 22. Reflow soldering footprint SOT223 (SC-73)**



**Fig 23. Wave soldering footprint SOT223 (SC-73)**



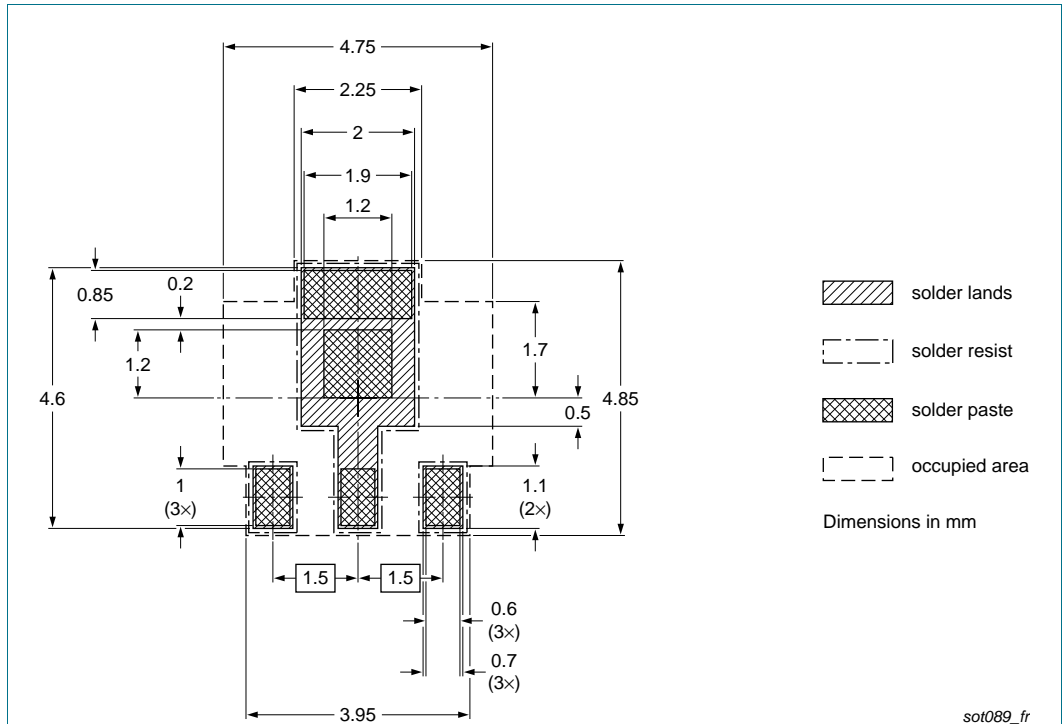


Fig 24. Reflow soldering footprint SOT89 (SC-62/TO-243)

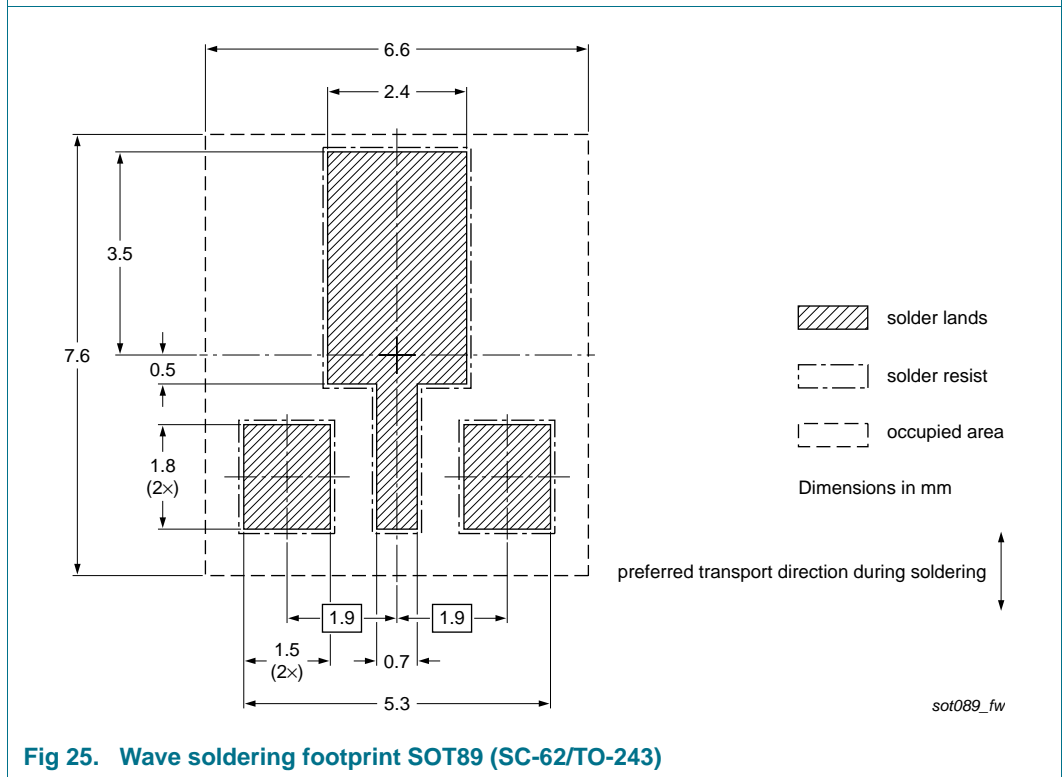
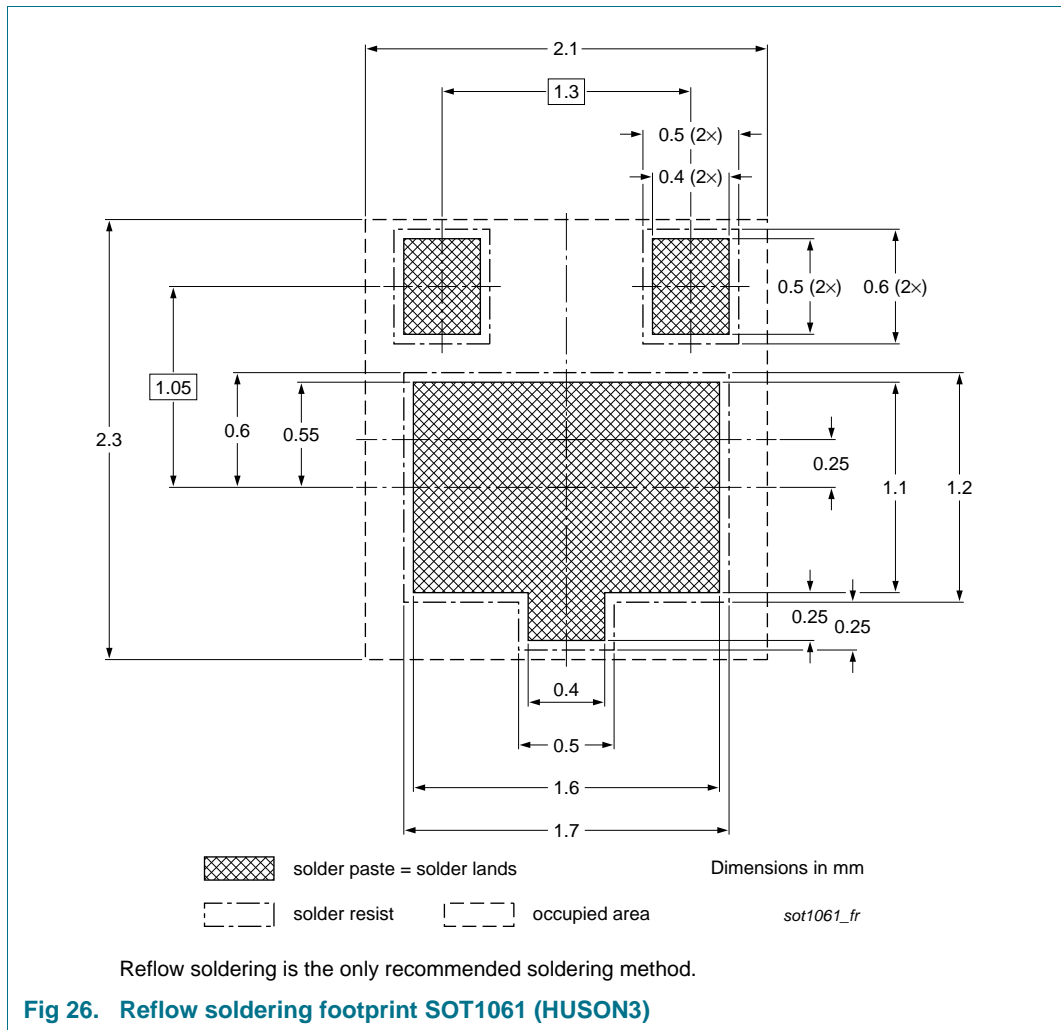


Fig 25. Wave soldering footprint SOT89 (SC-62/TO-243)



## 12. Revision history

Table 10. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BCP54_BCX54_BC54PA v.8	20111021	Product data sheet	-	BC635_BCP54_BCX54 v.7
Modifications:		<ul style="list-style-type: none"> <li>Type number removed: BC635</li> <li>Type numbers added: BC54PA, BC54-10PA and BC54-16PA</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, 2, 4, 5, 7</a> to <a href="#">9, 15, 17</a> and <a href="#">18</a>: updated</li> <li><a href="#">Figure 3, 6, 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>		
BC635_BCP54_BCX54 v.7	20070604	Product data sheet	-	BC635_BCP54_BCX54 v.6
BC635_BCP54_BCX54 v.6	20050225	Product data sheet	CPCN2004050 29	BC635_637_639 v.4 BCP54_55_56 v.5 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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