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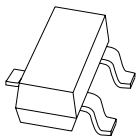


NUP1301

Ultra low capacitance ESD protection array

Rev. 01 — 11 May 2009 Product data sheet

1. Product profile

1.1 General description

Ultra low capacitance ElectroStatic Discharge (ESD) protection array in a small SOT23 (TO-236AB) Surface-Mounted Device (SMD) plastic package designed to protect one signal line in rail-to-rail configuration from the damage caused by ESD and other transients.

1.2 Features

- ESD protection of one signal line (rail-to-rail configuration)
- Ultra low diode capacitance: C_d = 0.6 pF
- Very low reverse leakage current: ≤ 30 nA
- ESD protection up to 30 kV
- IEC 61000-4-2; level 4 (ESD)
- IEC 61000-4-5 (surge); I_{PP} = 11 A at t_p = 8/20 µs
- AEC-Q101 qualified

1.3 Applications

- Telecommunication networks
- Video line protection
- Microcontroller protection
- I^2C-bus protection
- Antenna power supply
- Analog audio
- Class-D amplifier

1.4 Quick reference data

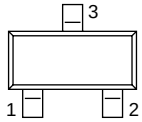
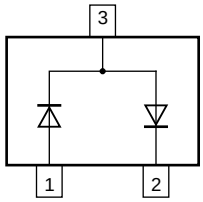
Table 1. Quick reference data

T_{amb} = 25 °C unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Per diode						
V_{RRM}	repetitive peak reverse voltage		-	-	80	V
C_d	diode capacitance	f = 1 MHz; V_R = 0 V	-	0.6	0.75	pF
I_R	reverse current	V_R = 80 V	-	-	100	nA

2. Pinning information

Table 2. Pinning

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	GND	ground		
2	V_{CC}	supply voltage		
3	I/O	input/output		

006aaa763

3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
NUP1301	-	plastic surface-mounted package; 3 leads	SOT23

4. Marking

Table 4. Marking

Type number	Marking code[1]
NUP1301	LJ*

[1] * = -: made in Hong Kong
* = p: made in Hong Kong
* = t: made in Malaysia
* = W: made in China

5. Limiting values

Table 5. Limiting values

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

Symbol	Parameter	Conditions		Min	Max	Unit
Per diode						
V_{RRM}	repetitive peak reverse voltage			-	80	V
V_R	reverse voltage			-	80	V
I_F	forward current		[1]	-	215	mA
I_{FRM}	repetitive peak forward current	$t_p \leq 1$ ms; $\delta \leq 0.25$		-	500	mA

Table 5. Limiting values *…continued*

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

Symbol	Parameter	Conditions		Min	Max	Unit
I_{FSM}	non-repetitive peak forward current	square wave	[2]			
		t_p = 1 µs		-	4	A
		t_p = 1 ms		-	1	A
		t_p = 1 s		-	0.5	A
Per device						
P_{PP}	peak pulse power	t_p = 8/20 µs	[3][4]	-	220	W
I_{PP}	peak pulse current	t_p = 8/20 µs	[3][4]	-	11	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	[5][6]	-	250	mW
T_j	junction temperature			-	150	°C
T_{amb}	ambient temperature			–55	+150	°C
T_{stg}	storage temperature			–65	+150	°C

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

[2] T_j = 25 °C prior to surge.

[3] Non-repetitive current pulse 8/20 µs exponential decay waveform according to IEC 61000-4-5.

[4] Measured from pin 3 to pins 1 and 2 (pins 1 and 2 are connected).

[5] Single diode loaded.

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

Table 6. ESD maximum ratings

Symbol	Parameter	Conditions		Min	Max	Unit
V_{ESD}	electrostatic discharge voltage	IEC 61000-4-2 (contact discharge)	[1][2]	-	30	kV
		machine model		-	400	V
		MIL-STD-883 (human body model)		-	10	kV

[1] Device stressed with ten non-repetitive ESD pulses.

[2] Measured from pin 3 to pins 1 and 2 (pins 1 and 2 are connected).

Table 7. ESD standards compliance

Standard	Conditions
IEC 61000-4-2; level 4 (ESD)	> 15 kV (air); > 8 kV (contact)
MIL-STD-883; class 3B (human body model)	> 8 kV

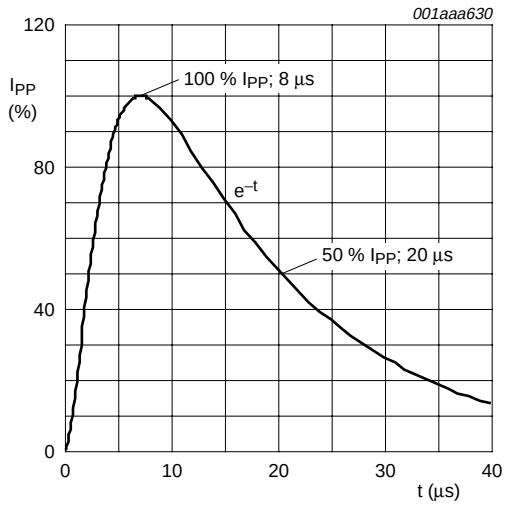


Fig 1. 8/20 µs pulse waveform according to IEC 61000-4-5

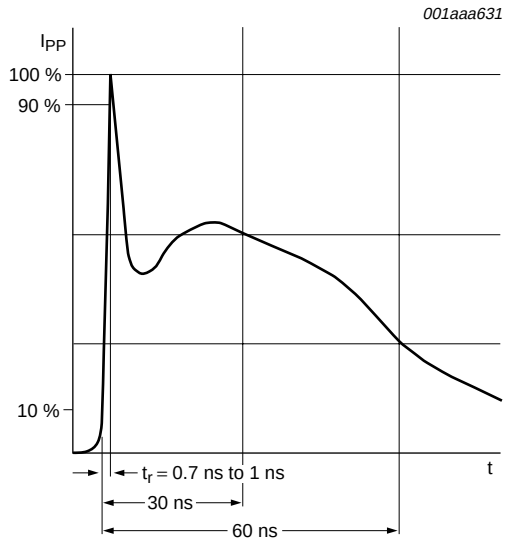


Fig 2. ESD pulse waveform according to IEC 61000-4-2

6. Thermal characteristics

Table 8. Thermal characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Per device							
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1][2]	-	-	500	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point			-	-	360	K/W

[1] Single diode loaded.

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

7. Characteristics

Table 9. Electrical characteristics

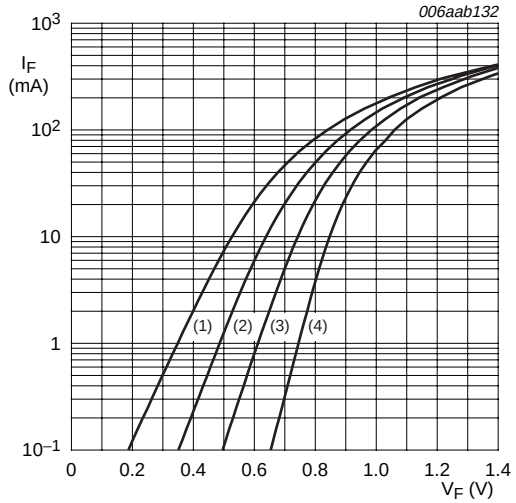
T_{amb} = 25 °C unless otherwise specified.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Per diode							
V_{BR}	breakdown voltage	I_R = 100 µA		100	-	-	V
V_F	forward voltage		[1]				
		I_F = 1 mA		-	-	715	mV
		I_F = 10 mA		-	-	855	mV
		I_F = 50 mA		-	-	1	V
		I_F = 150 mA		-	-	1.25	V
I_R	reverse current						
		V_R = 25 V		-	-	30	nA
		V_R = 80 V		-	-	100	nA
		V_R = 25 V; T_j = 150 °C		-	-	25	µA
		V_R = 80 V; T_j = 150 °C		-	-	35	µA
C_d	diode capacitance	f = 1 MHz; V_R = 0 V		-	0.6	0.75	pF
Per device							
V_{CL}	clamping voltage	I_{PP} = 1 A	[2][3]	-	-	3	V
		I_{PP} = 11 A	[2][3]	-	-	20	V

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

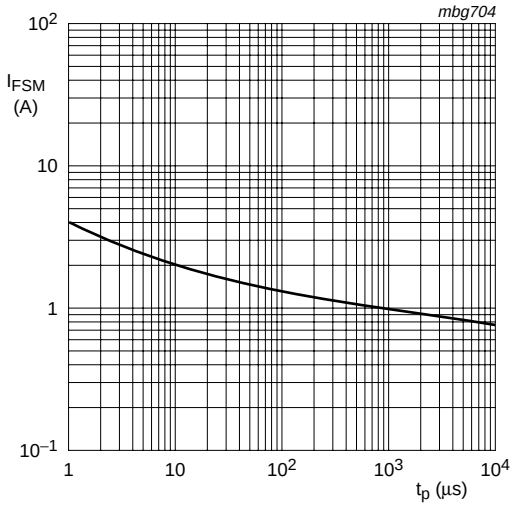
[2] Non-repetitive current pulse 8/20 µs exponential decay waveform according to IEC 61000-4-5.

[3] Measured from pin 3 to pins 1 and 2 (pins 1 and 2 are connected).



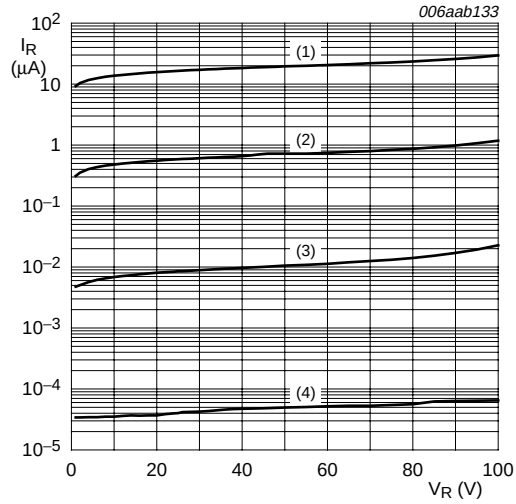
(1) T_{amb} = 150 °C
(2) T_{amb} = 85 °C
(3) T_{amb} = 25 °C
(4) T_{amb} = −40 °C

Fig 3. Forward current as a function of forward voltage; typical values



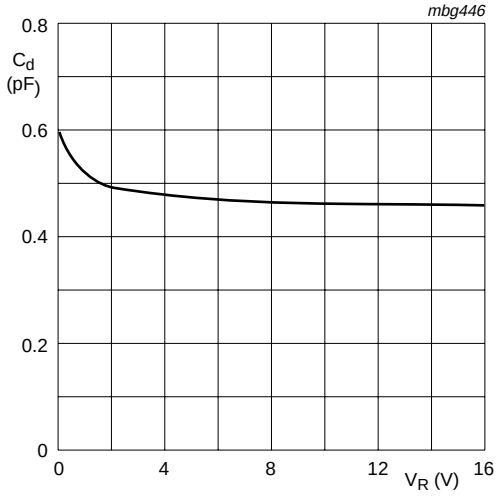
Based on square wave currents.
T_j = 25 °C; prior to surge

Fig 4. Non-repetitive peak forward current as a function of pulse duration; typical values



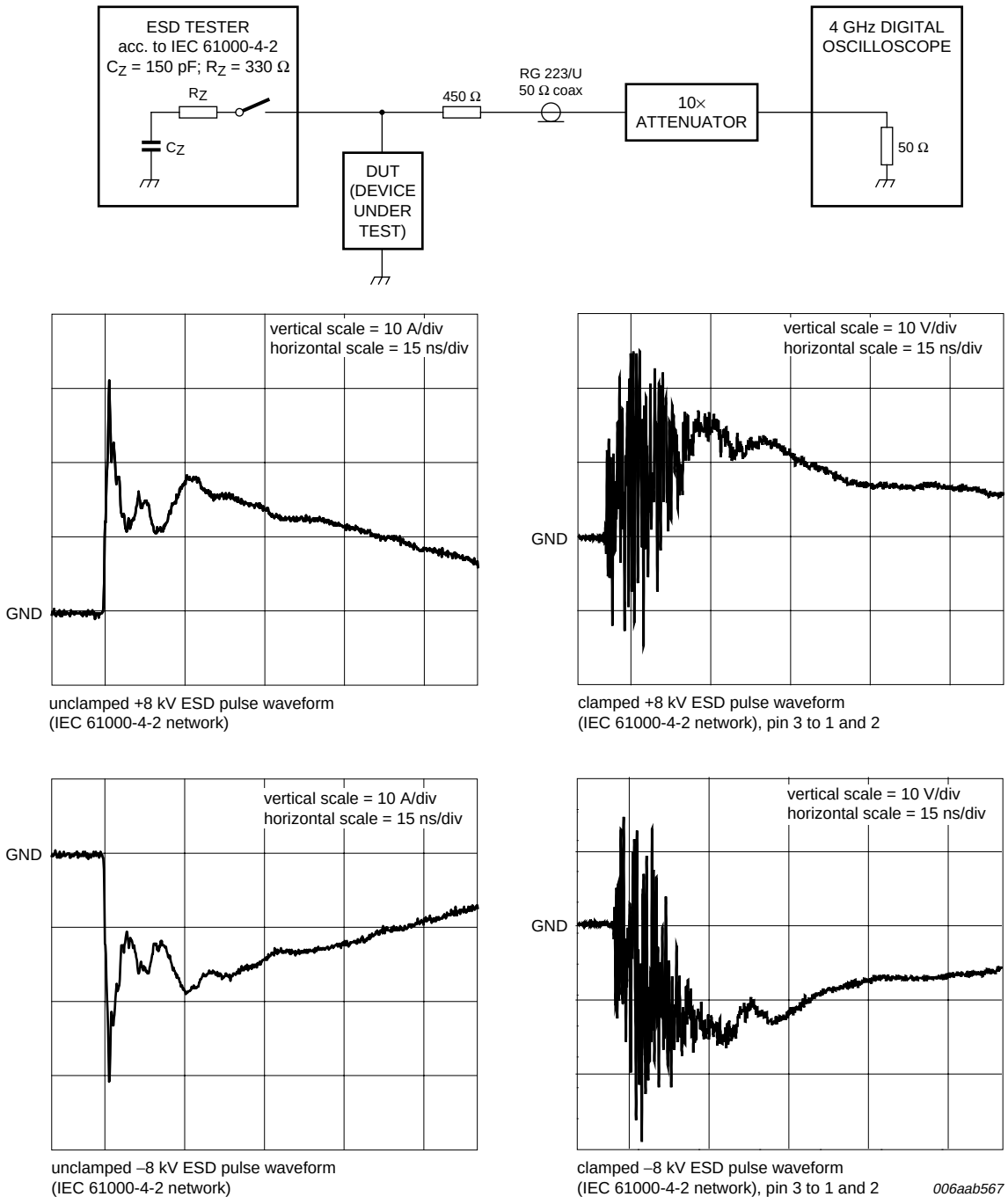
(1) T_{amb} = 150 °C
(2) T_{amb} = 85 °C
(3) T_{amb} = 25 °C
(4) T_{amb} = −40 °C

Fig 5. Reverse current as a function of reverse voltage; typical values



T_{amb} = 25 °C; f = 1 MHz

Fig 6. Diode capacitance as a function of reverse voltage; typical values



unclamped +8 kV ESD pulse waveform
(IEC 61000-4-2 network)

clamped +8 kV ESD pulse waveform
(IEC 61000-4-2 network), pin 3 to 1 and 2

unclamped −8 kV ESD pulse waveform
(IEC 61000-4-2 network)

clamped −8 kV ESD pulse waveform
(IEC 61000-4-2 network), pin 3 to 1 and 2

006aab567

Fig 7. ESD clamping test setup and waveforms

8. Application information

Protection of a single (high-speed) data line in rail-to-rail configuration. The protected data line is connected to pin 3. Pin 1 is connected to ground (GND) and pin 2 is connected to the supply rail (supply voltage V_{CC}.) When the transient voltage exceeds the forward voltage drop of one diode, the transient is directed either to the supply rail or to GND. The advantages of these solutions are: low line capacitance (0.6 pF typically), fast response time, and low clamping voltage.

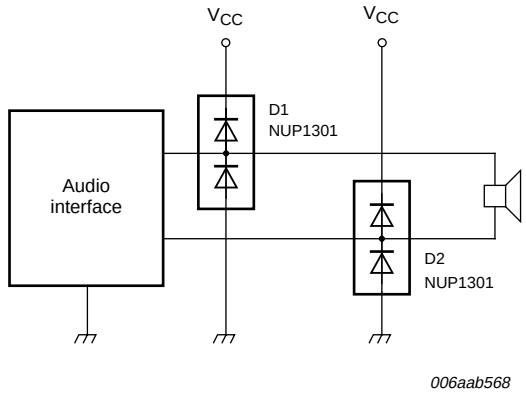


Fig 8. Typical application for the protection of one signal line

Circuit board layout and protection device placement:

Circuit board layout is critical for the suppression of ESD, Electrical Fast Transient (EFT) and surge transients. The following guidelines are recommended:

1. Place the NUP1301 as close to the input terminal or connector as possible.
2. The path length between the NUP1301 and the protected line should be minimized.
3. Keep parallel signal paths to a minimum.
4. Avoid running protected conductors in parallel with unprotected conductors.
5. Minimize all Printed-Circuit Board (PCB) conductive loops including power and ground loops.
6. Minimize the length of the transient return path to ground.
7. Avoid using shared transient return paths to a common ground point.
8. Ground planes should be used whenever possible. For multilayer PCBs, use ground vias.

9. Test information

9.1 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.

10. Package outline

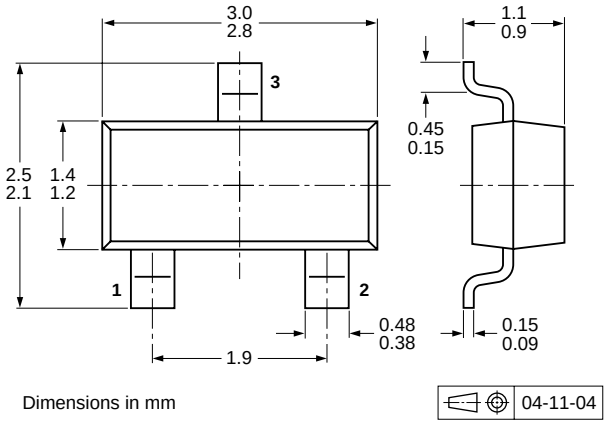


Fig 9. Package outline SOT23 (TO-236AB)

11. Packing information

Table 10. Packing methods

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

Type number	Package	Description	Packing quantity	
			3000	10000
NUP1301	SOT23	4 mm pitch, 8 mm tape and reel	-215	-235

[1] For further information and the availability of packing methods, see Section 15.

12. Soldering

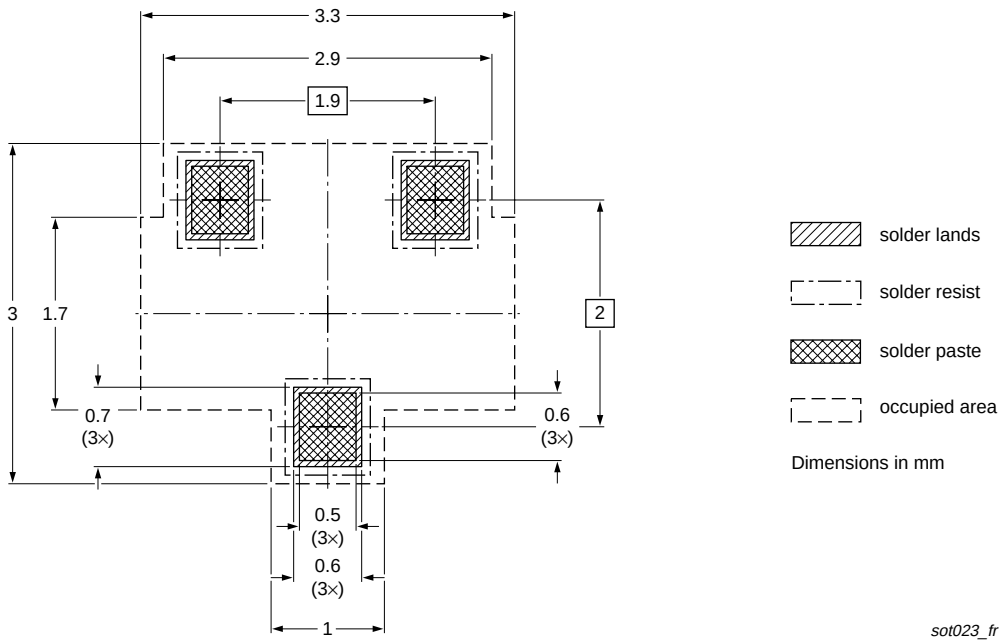


Fig 10. Reflow soldering footprint SOT23 (TO-236AB)

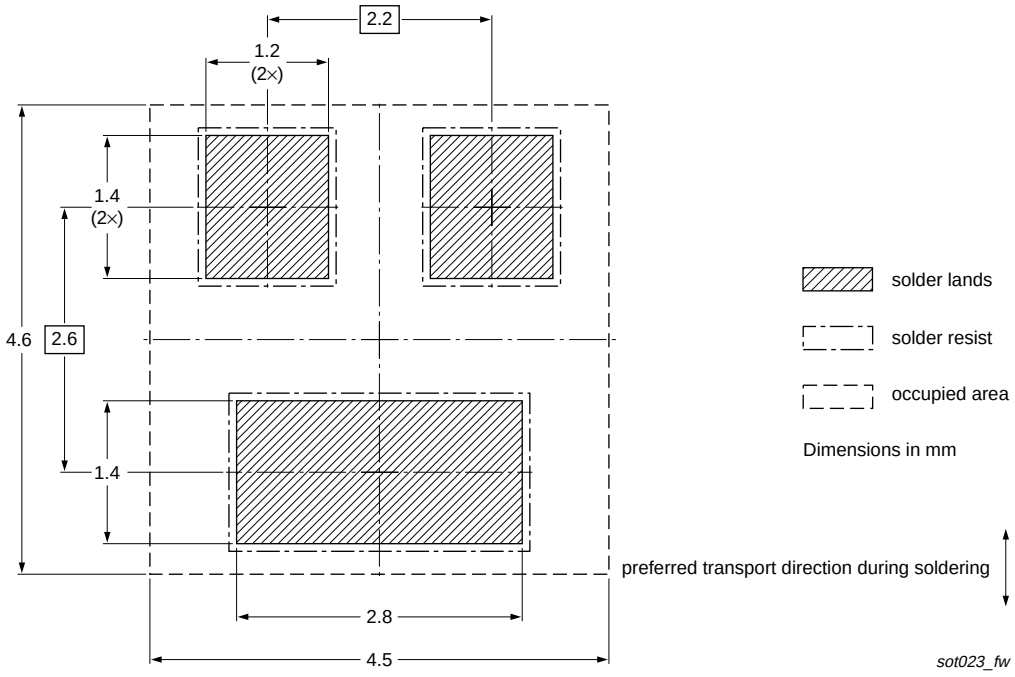


Fig 11. Wave soldering footprint SOT23 (TO-236AB)

13. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
NUP1301_1	20090511	Product data sheet	-	-

14. Legal information

14.1 Data sheet status

Document status[1][2]	Product status[3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

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Date of release: 11 May 2009
Document identifier: NUP1301_1