

MMBZxVCL; MMBZxVDL series

Double ESD protection diodes for transient overvoltage suppression

Rev. 01 — 3 September 2008 Product data sheet

1. Product profile

1.1 General description

Unidirectional double ElectroStatic Discharge (ESD) protection diodes in a common cathode configuration, encapsulated in a SOT23 (TO-236AB) small Surface-Mounted Device (SMD) plastic package. The devices are designed for ESD and transient overvoltage protection of up to two signal lines.

Table 1. Product overview

Type number[1]	Package		Configuration
	Nexperia	JEDEC	
MMBZ12VDL	SOT23	TO-236AB	dual common cathode
MMBZ15VDL			
MMBZ18VCL			
MMBZ20VCL			
MMBZ27VCL			
MMBZ33VCL			

[1] All types available as /DG halogen-free version.

1.2 Features

- Unidirectional ESD protection of two lines
- Bidirectional ESD protection of one line
- Low diode capacitance: $C_d \leq 140$ pF
- Rated peak pulse power: $P_{PPM} \leq 40$ W
- Ultra low leakage current: $I_{RM} \leq 5$ nA
- ESD protection up to 30 kV (contact discharge)
- IEC 61000-4-2; level 4 (ESD)
- IEC 61643-321
- AEC-Q101 qualified

1.3 Applications

- Computers and peripherals
- Audio and video equipment
- Cellular handsets and accessories
- Automotive electronic control units
- Portable electronics

1.4 Quick reference data

Table 2. Quick reference data

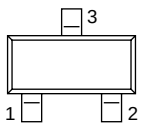
T_{amb} = 25 °C unless otherwise specified.

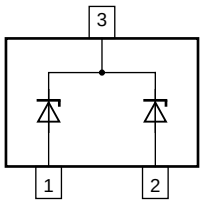
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Per diode						
V_{RWM}	reverse standoff voltage					
	MMBZ12VDL MMBZ12VDL/DG		-	-	8.5	V
	MMBZ15VDL MMBZ15VDL/DG		-	-	12.8	V
	MMBZ18VCL MMBZ18VCL/DG		-	-	14.5	V
	MMBZ20VCL MMBZ20VCL/DG		-	-	17	V
	MMBZ27VCL MMBZ27VCL/DG		-	-	22	V
	MMBZ33VCL MMBZ33VCL/DG		-	-	26	V
C_d	diode capacitance	f = 1 MHz; V_R = 0 V				
	MMBZ12VDL MMBZ12VDL/DG		-	110	140	pF
	MMBZ15VDL MMBZ15VDL/DG		-	85	105	pF
	MMBZ18VCL MMBZ18VCL/DG		-	70	90	pF
	MMBZ20VCL MMBZ20VCL/DG		-	65	80	pF
	MMBZ27VCL MMBZ27VCL/DG		-	48	60	pF
	MMBZ33VCL MMBZ33VCL/DG		-	45	55	pF

2. Pinning information

Table 3. Pinning

Pin	Description	Simplified outline	Graphic symbol
1	anode (diode 1)		
2	anode (diode 2)		
3	common cathode		





006aaa150

© Nexperia B.V. 2017. All rights reserved

3. Ordering information

Table 4. Ordering information

Type number	Package		
	Name	Description	Version
MMBZ12VDL	-	plastic surface-mounted package; 3 leads	SOT23
MMBZ15VDL			
MMBZ18VCL			
MMBZ20VCL			
MMBZ27VCL			
MMBZ33VCL			
MMBZ12VDL/DG	-	plastic surface-mounted package; 3 leads	SOT23
MMBZ15VDL/DG			
MMBZ18VCL/DG			
MMBZ20VCL/DG			
MMBZ27VCL/DG			
MMBZ33VCL/DG			

4. Marking

Table 5. Marking codes

Type number	Marking code[1]	Type number	Marking code[1]
MMBZ12VDL	*MA	MMBZ12VDL/DG	TJ*
MMBZ15VDL	*MB	MMBZ15VDL/DG	TL*
MMBZ18VCL	*MC	MMBZ18VCL/DG	TN*
MMBZ20VCL	*MD	MMBZ20VCL/DG	TQ*
MMBZ27VCL	*ME	MMBZ27VCL/DG	TS*
MMBZ33VCL	*MF	MMBZ33VCL/DG	TU*

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

© Nexperia B.V. 2017. All rights reserved

5. Limiting values

Table 6. Limiting values

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

Symbol	Parameter	Conditions		Min	Max	Unit
Per diode						
P_{PPM}	rated peak pulse power	t_p = 10/1000 µs	[1][2]	-	40	W
I_{PPM}	rated peak pulse current	t_p = 10/1000 µs	[1][2]			
	MMBZ12VDL MMBZ12VDL/DG			-	2.35	A
	MMBZ15VDL MMBZ15VDL/DG			-	1.9	A
	MMBZ18VCL MMBZ18VCL/DG			-	1.6	A
	MMBZ20VCL MMBZ20VCL/DG			-	1.4	A
	MMBZ27VCL MMBZ27VCL/DG			-	1	A
	MMBZ33VCL MMBZ33VCL/DG			-	0.87	A
Per device						
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	[3]	-	350	mW
			[4]	-	440	mW
T_j	junction temperature			-	150	°C
T_{amb}	ambient temperature			–55	+150	°C
T_{stg}	storage temperature			–65	+150	°C

[1] In accordance with IEC 61643-321 (10/1000 µs current waveform).

[2] Measured from pin 1 or 2 to pin 3.

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

[4] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for cathode 1 cm^2.

Table 7. ESD maximum ratings

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

Symbol	Parameter	Conditions		Min	Max	Unit
Per diode						
V_{ESD}	electrostatic discharge voltage		[1][2]			
		IEC 61000-4-2 (contact discharge)		-	30	kV
		machine model		-	2	kV

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

[2] Measured from pin 1 or 2 to pin 3.

© Nexperia B.V. 2017. All rights reserved

Table 8. ESD standards compliance

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

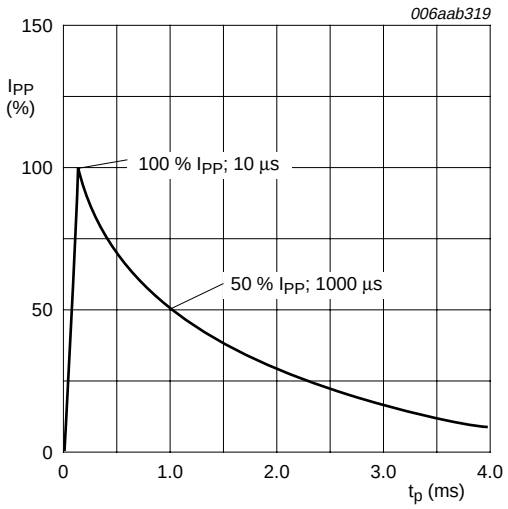


Fig 1. 10/1000 µs pulse waveform according to IEC 61643-321

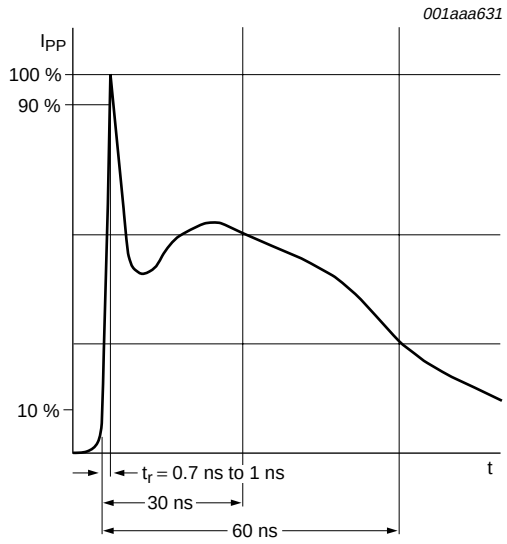


Fig 2. ESD pulse waveform according to IEC 61000-4-2

6. Thermal characteristics

Table 9. 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]	-	-	350	K/W
			[2]	-	-	280	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point		[3]	-	-	60	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 cathode 1 cm^2.

[3] Soldering point at pin 3.

© Nexperia B.V. 2017. All rights reserved

7. Characteristics

Table 10. Characteristics

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Per diode						
V_F	forward voltage					
	MMBZ12VDL MMBZ12VDL/DG	I_F = 10 mA	-	-	0.9	V
	MMBZ15VDL MMBZ15VDL/DG	I_F = 10 mA	-	-	0.9	V
	MMBZ18VCL MMBZ18VCL/DG	I_F = 10 mA	-	-	0.9	V
	MMBZ20VCL MMBZ20VCL/DG	I_F = 10 mA	-	-	0.9	V
	MMBZ27VCL MMBZ27VCL/DG	I_F = 200 mA	-	-	1.1	V
	MMBZ33VCL MMBZ33VCL/DG	I_F = 10 mA	-	-	0.9	V
V_{RWM}	reverse standoff voltage					
	MMBZ12VDL MMBZ12VDL/DG		-	-	8.5	V
	MMBZ15VDL MMBZ15VDL/DG		-	-	12.8	V
	MMBZ18VCL MMBZ18VCL/DG		-	-	14.5	V
	MMBZ20VCL MMBZ20VCL/DG		-	-	17	V
	MMBZ27VCL MMBZ27VCL/DG		-	-	22	V
	MMBZ33VCL MMBZ33VCL/DG		-	-	26	V
I_{RM}	reverse leakage current					
	MMBZ12VDL MMBZ12VDL/DG	V_{RWM} = 8.5 V	-	0.1	5	nA
	MMBZ15VDL MMBZ15VDL/DG	V_{RWM} = 12.8 V	-	0.1	5	nA
	MMBZ18VCL MMBZ18VCL/DG	V_{RWM} = 14.5 V	-	0.1	5	nA
	MMBZ20VCL MMBZ20VCL/DG	V_{RWM} = 17 V	-	0.1	5	nA
	MMBZ27VCL MMBZ27VCL/DG	V_{RWM} = 22 V	-	0.1	5	nA
	MMBZ33VCL MMBZ33VCL/DG	V_{RWM} = 26 V	-	0.1	5	nA

© Nexperia B.V. 2017. All rights reserved

Table 10. Characteristics *...continued*

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{BR}	breakdown voltage	I_R = 1 mA				
	MMBZ12VDL MMBZ12VDL/DG		11.4	12	12.6	V
	MMBZ15VDL MMBZ15VDL/DG		14.3	15	15.8	V
	MMBZ18VCL MMBZ18VCL/DG		17.1	18	18.9	V
	MMBZ20VCL MMBZ20VCL/DG		19	20	21	V
	MMBZ27VCL MMBZ27VCL/DG		25.65	27	28.35	V
	MMBZ33VCL MMBZ33VCL/DG		31.35	33	34.65	V
C_d	diode capacitance	f = 1 MHz; V_R = 0 V				
	MMBZ12VDL MMBZ12VDL/DG		-	110	140	pF
	MMBZ15VDL MMBZ15VDL/DG		-	85	105	pF
	MMBZ18VCL MMBZ18VCL/DG		-	70	90	pF
	MMBZ20VCL MMBZ20VCL/DG		-	65	80	pF
	MMBZ27VCL MMBZ27VCL/DG		-	48	60	pF
	MMBZ33VCL MMBZ33VCL/DG		-	45	55	pF
V_{CL}	clamping voltage	[1][2]				
	MMBZ12VDL MMBZ12VDL/DG	I_{PPM} = 2.35 A	-	-	17	V
	MMBZ15VDL MMBZ15VDL/DG	I_{PPM} = 1.9 A	-	-	21.2	V
	MMBZ18VCL MMBZ18VCL/DG	I_{PPM} = 1.6 A	-	-	25	V
	MMBZ20VCL MMBZ20VCL/DG	I_{PPM} = 1.4 A	-	-	28	V
	MMBZ27VCL MMBZ27VCL/DG	I_{PPM} = 1 A	-	-	38	V
	MMBZ33VCL MMBZ33VCL/DG	I_{PPM} = 0.87 A	-	-	46	V

© Nexperia B.V. 2017. All rights reserved

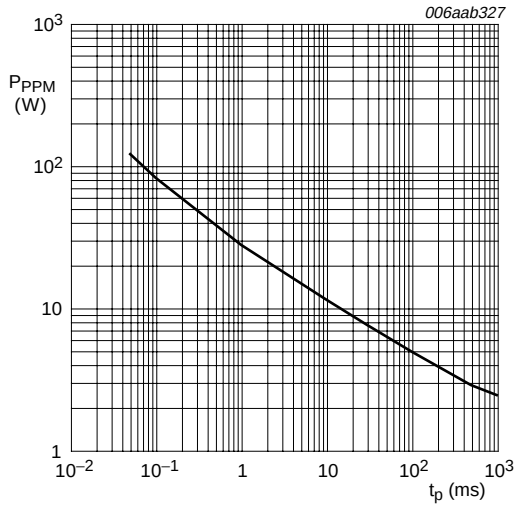
Table 10. Characteristics *...continued*

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
S_Z	temperature coefficient	I_Z = 1 mA				
	MMBZ12VDL MMBZ12VDL/DG		-	8.1	-	mV/K
	MMBZ15VDL MMBZ15VDL/DG		-	11	-	mV/K
	MMBZ18VCL MMBZ18VCL/DG		-	14	-	mV/K
	MMBZ20VCL MMBZ20VCL/DG		-	15.8	-	mV/K
	MMBZ27VCL MMBZ27VCL/DG		-	23	-	mV/K
	MMBZ33VCL MMBZ33VCL/DG		-	29.4	-	mV/K

[1] In accordance with IEC 61643-321 (10/1000 µs current waveform).

[2] Measured from pin 1 or 2 to pin 3.



MMBZ27VCL: unidirectional and bidirectional

T_{amb} = 25 °C

Fig 3. Rated peak pulse power as a function of exponential pulse duration (rectangular waveform); typical values

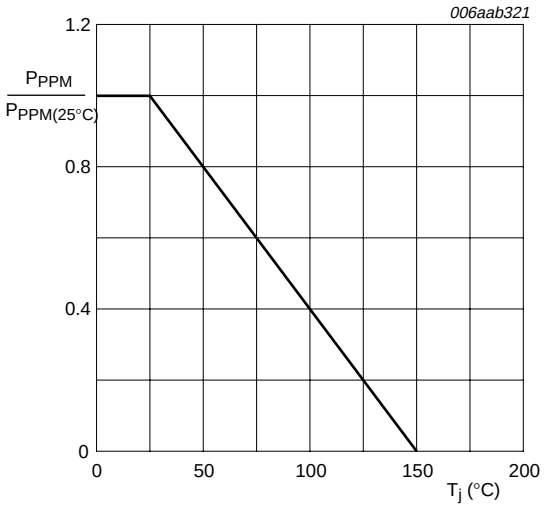
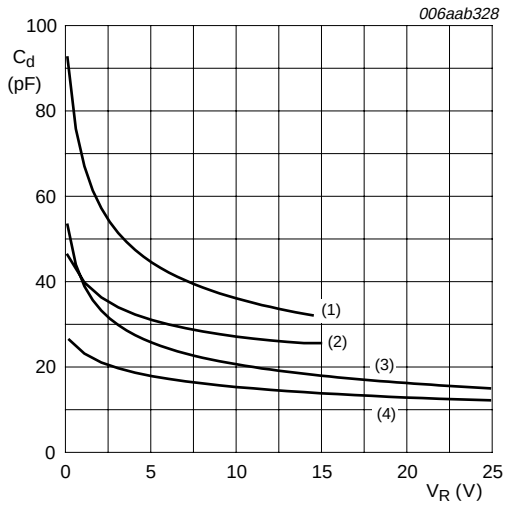


Fig 4. Relative variation of rated peak pulse power as a function of junction temperature; typical values

© Nexperia B.V. 2017. All rights reserved



f = 1 MHz; T_{amb} = 25 °C

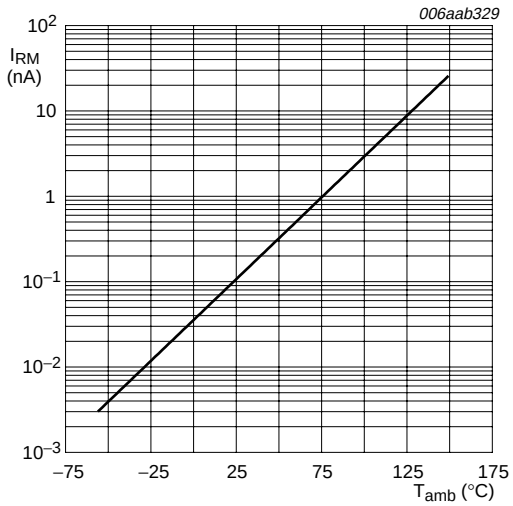
(1) MMBZ15VDL: unidirectional

(2) MMBZ15VDL: bidirectional

(3) MMBZ27VCL: unidirectional

(4) MMBZ27VCL: bidirectional

Fig 5. Diode capacitance as a function of reverse voltage; typical values



MMBZ27VCL: V_{RWM} = 22 V

Fig 6. Reverse leakage current as a function of junction temperature; typical values

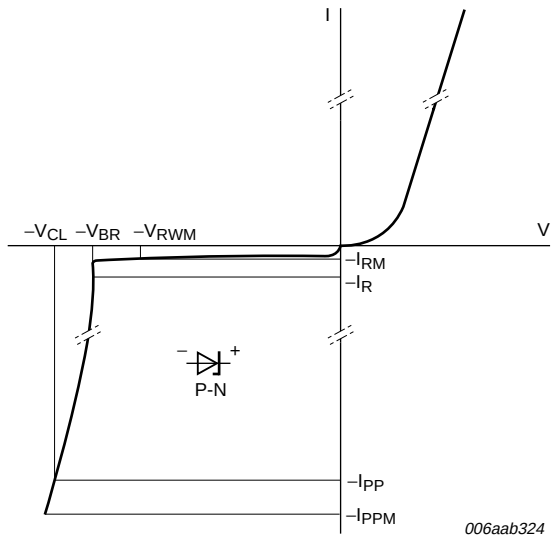


Fig 7. V-I characteristics for a unidirectional ESD protection diode

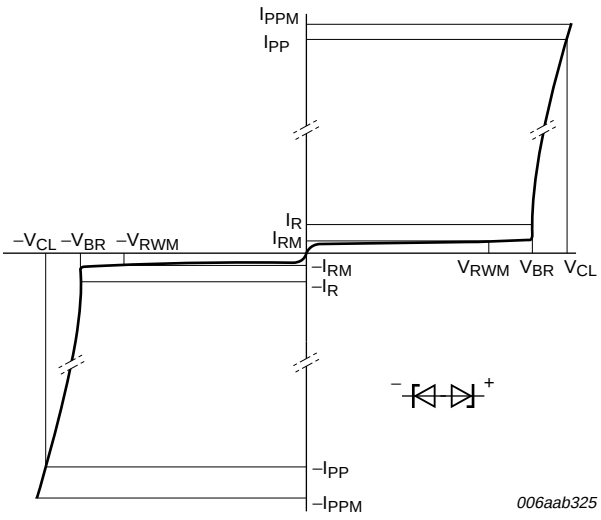


Fig 8. V-I characteristics for a bidirectional ESD protection diode

© Nexperia B.V. 2017. All rights reserved

8. Application information

The MMBZxVCL series and the MMBZxVDL series are designed for the protection of up to two unidirectional data or signal lines from the damage caused by ESD and surge pulses. The devices may be used on lines where the signal polarities are either positive or negative with respect to ground. The devices provide a surge capability of 40 W per line for a 10/1000 μs waveform.

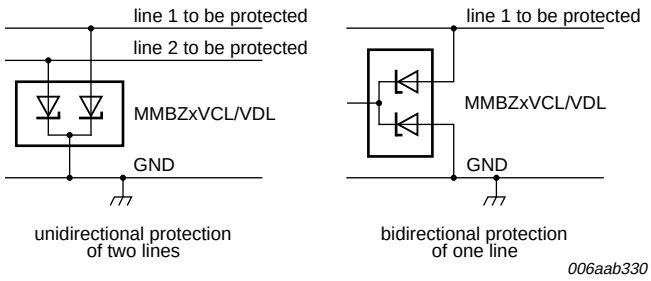


Fig 9. Typical application: ESD and transient voltage protection of data lines

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 devices as close to the input terminal or connector as possible.
2. The path length between the device 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.

© Nexperia B.V. 2017. All rights reserved

10. Package outline

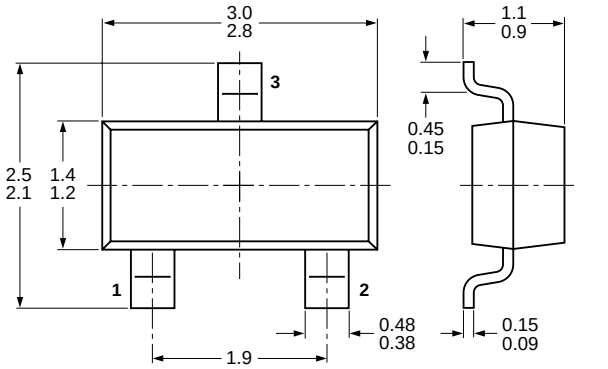


Fig 10. Package outline SOT23 (TO-236AB)

11. Packing information

Table 11. Packing methods

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

Type number	Package	Description	Packing quantity	
			3000	10000
MMBZ12VDL	SOT23	4 mm pitch, 8 mm tape and reel	-215	-235
MMBZ15VDL				
MMBZ18VCL				
MMBZ20VCL				
MMBZ27VCL				
MMBZ33VCL				
MMBZ12VDL/DG	SOT23	4 mm pitch, 8 mm tape and reel	-215	-235
MMBZ15VDL/DG				
MMBZ18VCL/DG				
MMBZ20VCL/DG				
MMBZ27VCL/DG				
MMBZ33VCL/DG				

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

© Nexperia B.V. 2017. All rights reserved

12. Soldering

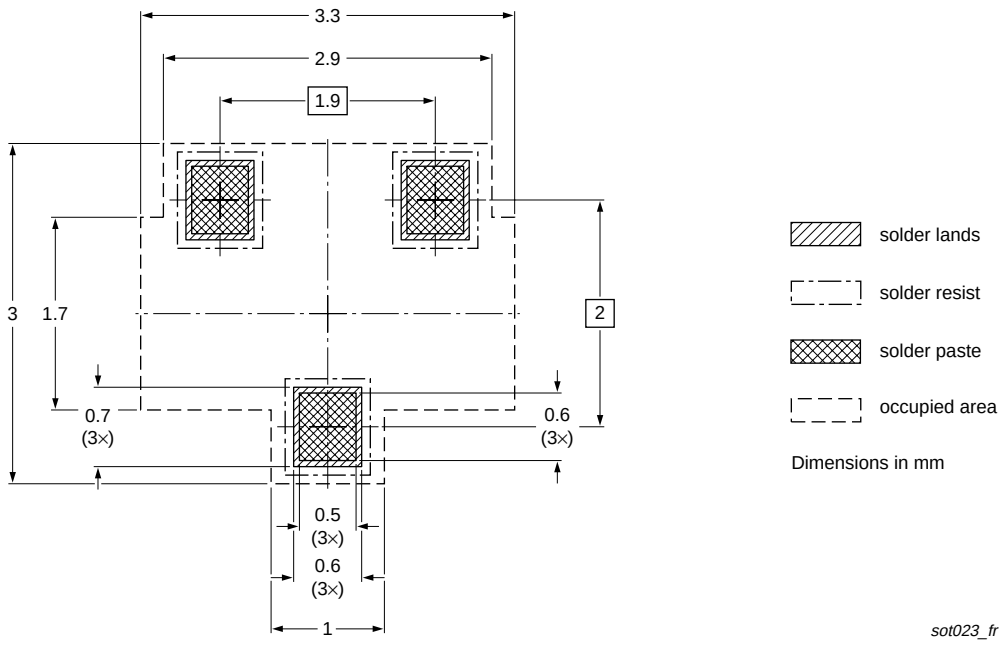


Fig 11. Reflow soldering footprint SOT23 (TO-236AB)

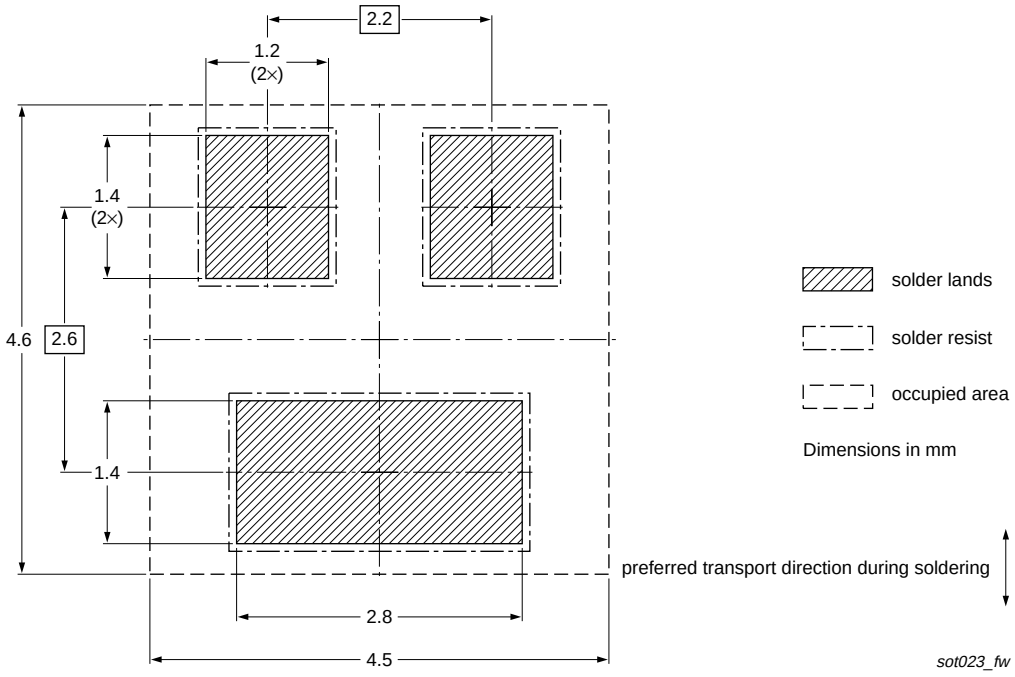


Fig 12. Wave soldering footprint SOT23 (TO-236AB)

© Nexperia B.V. 2017. All rights reserved

13. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
MMBZXVCL_MMBZXVDL_SER_1	20080903	Product data sheet	-	-

© Nexperia B.V. 2017. All rights reserved

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".

[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.

14.2 Definitions

Draft — The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. Nexperia does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

Short data sheet — A short data sheet is an extract from a full data sheet with the same product type number(s) and title. A short data sheet is intended for quick reference only and should not be relied upon to contain detailed and full information. For detailed and full information see the relevant full data sheet, which is available on request via the local Nexperia sales office. In case of any inconsistency or conflict with the short data sheet, the full data sheet shall prevail.

14.3 Disclaimers

General — Information in this document is believed to be accurate and reliable. However, Nexperia does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information.

Right to make changes — Nexperia reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

Suitability for use — Nexperia products are not designed, authorized or warranted to be suitable for use in medical, military, aircraft, space or life support equipment, nor in applications where failure or malfunction of a Nexperia product can reasonably be expected to result in personal injury, death or severe property or environmental damage. Nexperia accepts no liability for inclusion and/or use of Nexperia products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

Applications — Applications that are described herein for any of these products are for illustrative purposes only. Nexperia makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Limiting values — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) may cause permanent damage to the device. Limiting values are stress ratings only and operation of the device at these or any other conditions above those given in the Characteristics sections of this document is not implied. Exposure to limiting values for extended periods may affect device reliability.

Terms and conditions of sale — Nexperia products are sold subject to the general terms and conditions of commercial sale, as published at http://www.nexperia.com/profile/terms, including those pertaining to warranty, intellectual property rights infringement and limitation of liability, unless explicitly otherwise agreed to in writing by Nexperia. In case of any inconsistency or conflict between information in this document and such terms and conditions, the latter will prevail.

No offer to sell or license — Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

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.

ESD protection devices — These products are only intended for protection against ElectroStatic Discharge (ESD) pulses and are not intended for any other usage including, without limitation, voltage regulation applications. Nexperia accepts no liability for use in such applications and therefore such use is at the customer's own risk.

14.4 Trademarks

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

15. Contact information

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

For sales office addresses, please send an email to: **salesaddresses@nexperia.com**

© Nexperia B.V. 2017. All rights reserved

16. Contents

1 Product profile 1
1.1 General description 1
1.2 Features 1
1.3 Applications 1
1.4 Quick reference data 2
2 Pinning information 2
3 Ordering information 3
4 Marking 3
5 Limiting values 4
6 Thermal characteristics 5
7 Characteristics 6
8 Application information 10
9 Test information 10
9.1 Quality information 10
10 Package outline 11
11 Packing information 11
12 Soldering 12
13 Revision history 13
14 Legal information 14
14.1 Data sheet status 14
14.2 Definitions 14
14.3 Disclaimers 14
14.4 Trademarks 14
15 Contact information 14
16 Contents 15

© **Nexperia B.V. 2017. All rights reserved**

For more information, please visit: http://www.nexperia.com
For sales office addresses, please send an email to: salesaddresses@nexperia.com
Date of release: 03 September 2008