MMBZ16VAL-Q

High surge current unidirectional double ESD protection diode

4 October 2022 Product data sheet

1. General description

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

2. Features and benefits

- Unidirectional protection of two lines
- Reverse standoff voltage: V_{RWM} = 13 V
- Average measured surge robustness: I_{PPM} = 14 A (8/20 µs) / I_{PPM} = 2.54 A (10/1000 µs)
- Typical reverse leakage current: I_{RM} = 0.1 nA
- Qualified according to AEC-Q101 and recommended for use in automotive applications

3. Applications

- Automotive in-vehicle networks protection
- Industrial application
- Power management

4. Quick reference data

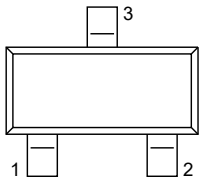
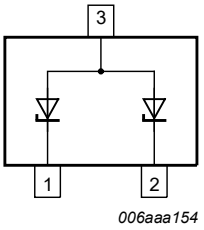
Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{RWM}	reverse standoff voltage	T_j = 25 °C		-	-	13	V
I_{PPM}	rated peak pulse current	t_p = 10/1000 µs	[1] [2]	-	-	1.9	A
V_{CL}	clamping voltage	I_{PP} = 1.7 A; t_p = 10/1000 µs; T_j = 25 °C	[1] [2]	-	19.5	23	V

[1] According to IEC 61643-321.
[2] Measured from pin 1 or 2 to pin 3.

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	K1	cathode	 SOT23	 006aaa154
2	K2	cathode		
3	A	common anode		

6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
MMBZ16VAL-Q	SOT23	plastic, surface-mounted package; 3 terminals; 1.9 mm pitch; 2.9 mm x 1.3 mm x 1 mm body	SOT23

7. Marking

Table 4. Marking codes

Type number	Marking code[1]
MMBZ16VAL-Q	%H7

[1] % = placeholder for manufacturing site code

8. Limiting values

Table 5. Limiting values

In accordance with the Aboluste Maximum Rating System (IEC 60134)

Symbol	Parameter	Conditions		Min	Max	Unit
P_{PPM}	rated peak pulse power	t_p = 8/20 µs	[1] [2]	-	300	W
		t_p = 10/1000 µs	[3] [2]	-	45	W
I_{PPM}	rated peak pulse current	t_p = 8/20 µs	[1] [2]	-	11	A
		t_p = 10/1000 µs	[3] [2]	-	1.9	A
T_j	junction temperature			-	150	°C
T_{amb}	ambient temperature			-55	150	°C
T_{stg}	storage temperature			-65	150	°C
ESD maximum ratings						
V_{ESD}	electrostatic discharge voltage	IEC 61000-4-2; contact discharge	[4] [2]	-	30	kV
		IEC 61000-4-2; air discharge	[4] [2]	-	30	kV

[1] According to IEC 61000-4-5.
[2] Measured from pin 1 or 2 to pin 3.
[3] According to IEC 61643-321.
[4] Device stressed with ten non-repetitive ESD pulses.

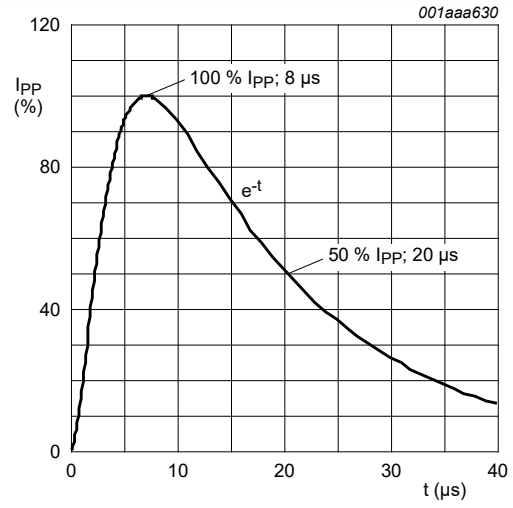


Fig. 1. 8/20 µs pulse waveform according to IEC 61000-4-5

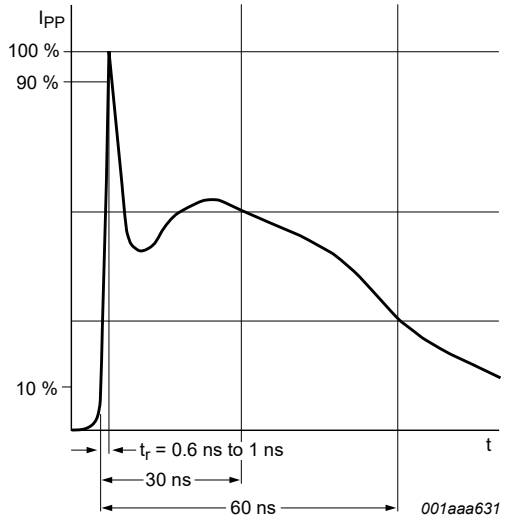


Fig. 2. ESD pulse waveform according to IEC 61000-4-2

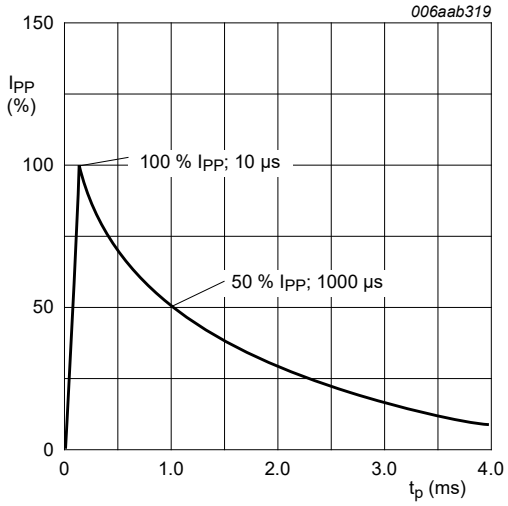


Fig. 3. 10/1000 µs pulse waveform according to IEC 61643-321

9. Characteristics

Table 6. Characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{RWM}	reverse standoff voltage	T_j = 25 °C		-	-	13	V
V_{BR}	breakdown voltage	I_R = 1 mA; T_j = 25 °C	[1]	15.2	16	16.8	V
I_{RM}	reverse leakage current	V_{RWM} = 13 V; T_j = 25 °C	[1]	-	0.1	5	nA
C_d	diode capacitance	f = 1 MHz; V_R = 0 V; T_j = 25 °C	[1]	-	76	95	pF
V_{CL}	clamping voltage	I_{PP} = 11 A; t_p = 8/20 µs; T_j = 25 °C	[2] [1]	-	23	28	V
		I_{PP} = 1.7 A; t_p = 10/1000 µs; T_j = 25 °C	[3] [1]	-	19.5	23	V

[1] Measured from pin 1 or 2 to pin 3.
[2] According to IEC 61000-4-5.
[3] According to IEC 61643-321.

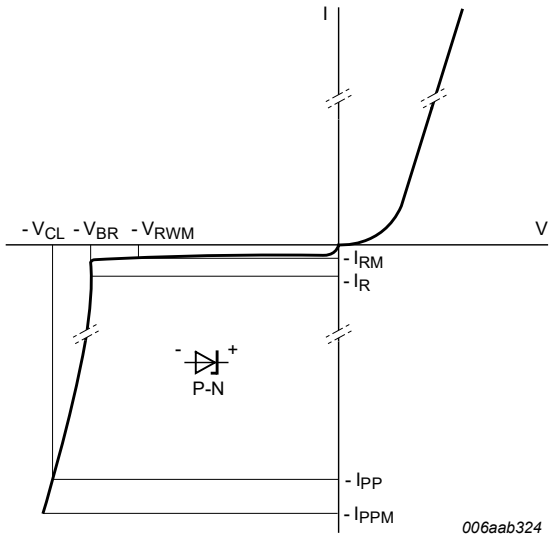


Fig. 4. V-I characteristics for a unidirectional TVS protection diode

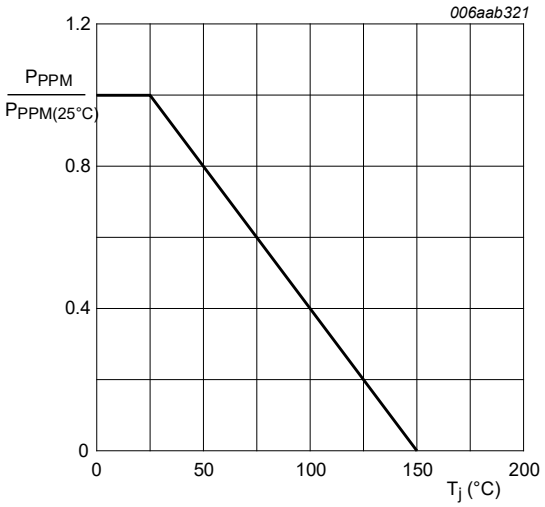


Fig. 5. Relative variation of rated peak pulse power as a function of junction temperature; typical values

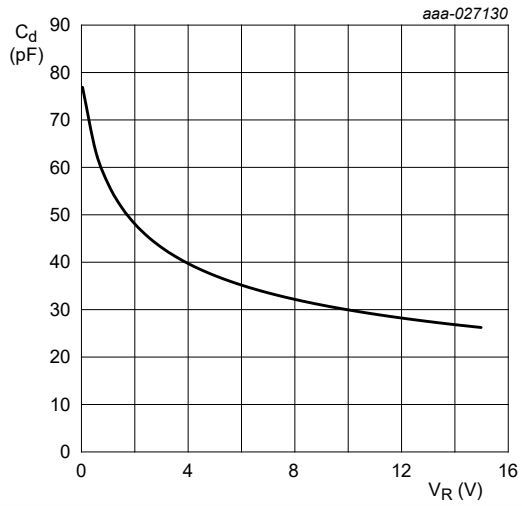


Fig. 6. Diode capacitance as a function of reverse voltage; typical values

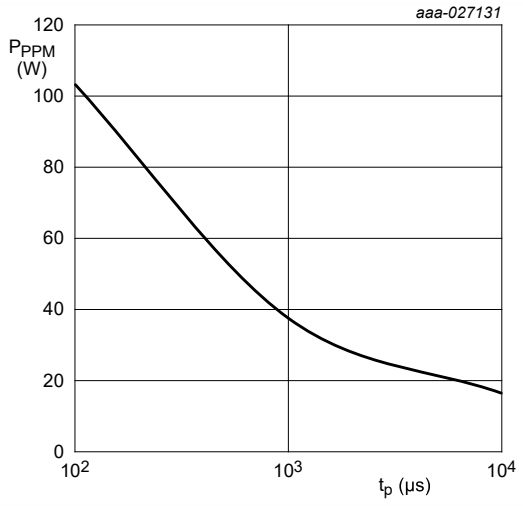
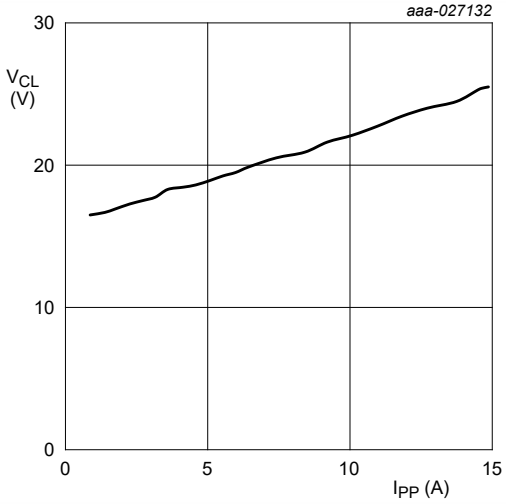
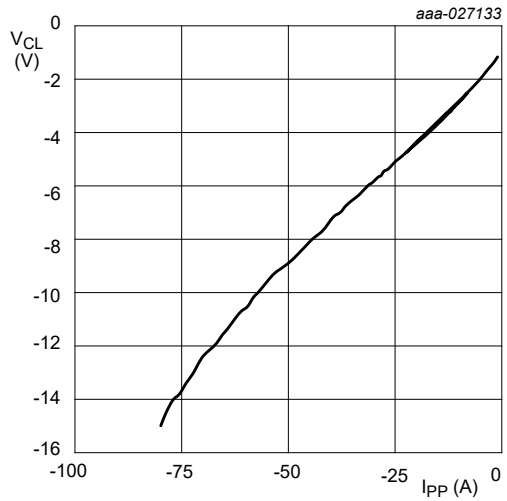


Fig. 7. Rated peak pulse power as a function of a pulse duration; typical values



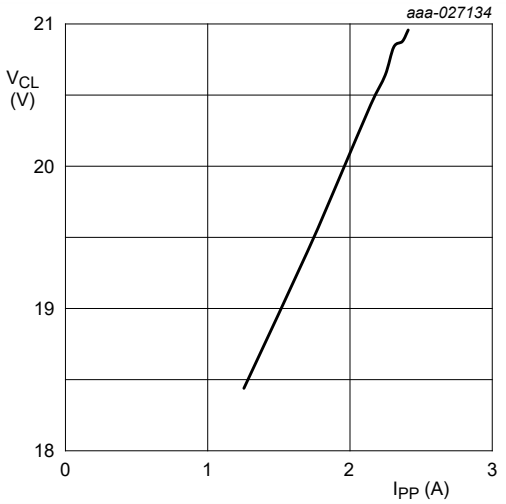
t_p = 8/20 µs; according to IEC 61000-4-5

Fig. 8. Positive clamping voltage (8/20 µs pulse); typical values



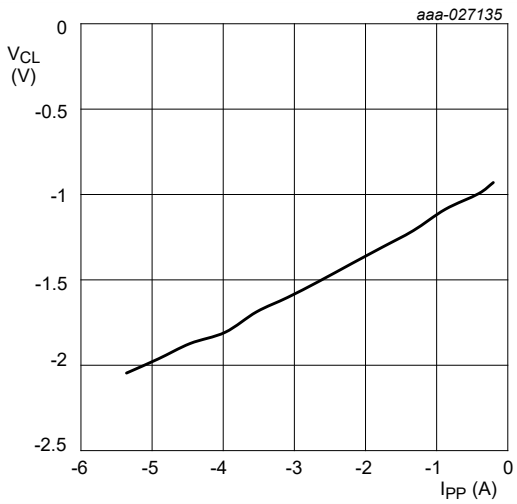
t_p = 8/20 µs; according to IEC 61000-4-5

Fig. 9. Negative clamping voltage (8/20 µs pulse); typical values



t_p = 10/1000 µs; according to IEC 61643-321

Fig. 10. Positive clamping voltage (10/1000 µs pulse); typical values



t_p = 10/1000 µs; according to IEC 61643-321

Fig. 11. Negative clamping voltage (10/1000 µs pulse); typical values

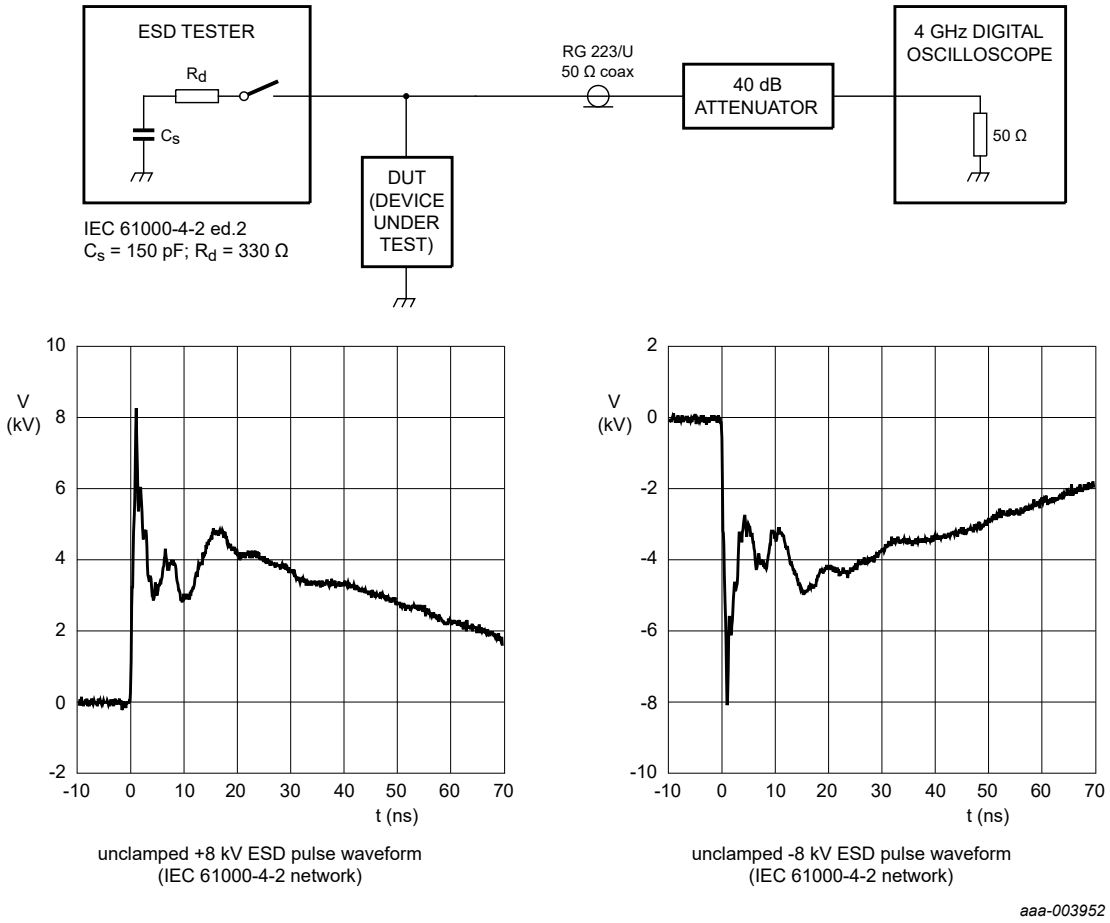


Fig. 12. ESD clamping test setup and waveforms

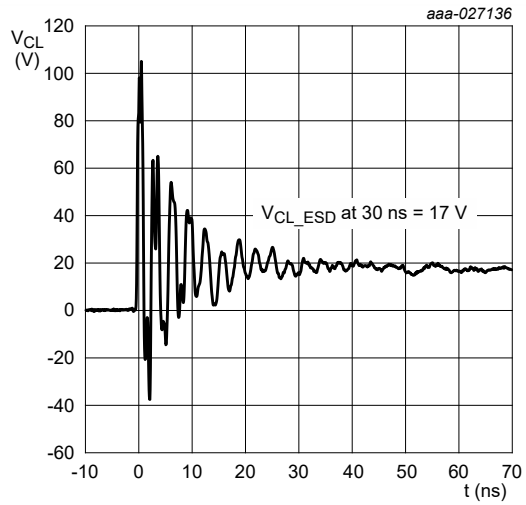


Fig. 13. Clamped +8 kV pulse waveform (IEC61000-4-2 network)

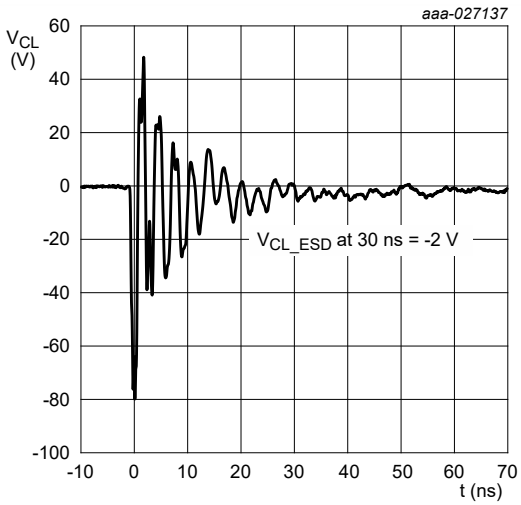


Fig. 14. Clamped -8 kV pulse waveform (IEC61000-4-2 network)

10. Application information

The device is designed for the protection of up to two unidirectional data lines from the damage caused by ESD and surge pulses. The device may be used on lines where the signal polarities are either positive or negative with respect to ground.

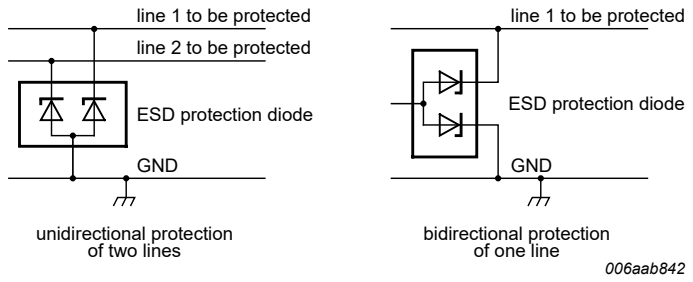


Fig. 15. Typical application: ESD and transient voltage protection of data lines

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 device as close to the input terminal or connector as possible.
2. Minimize the path length between the device and the protected line.
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. Use ground planes whenever possible. For multilayer PCBs, use ground vias.

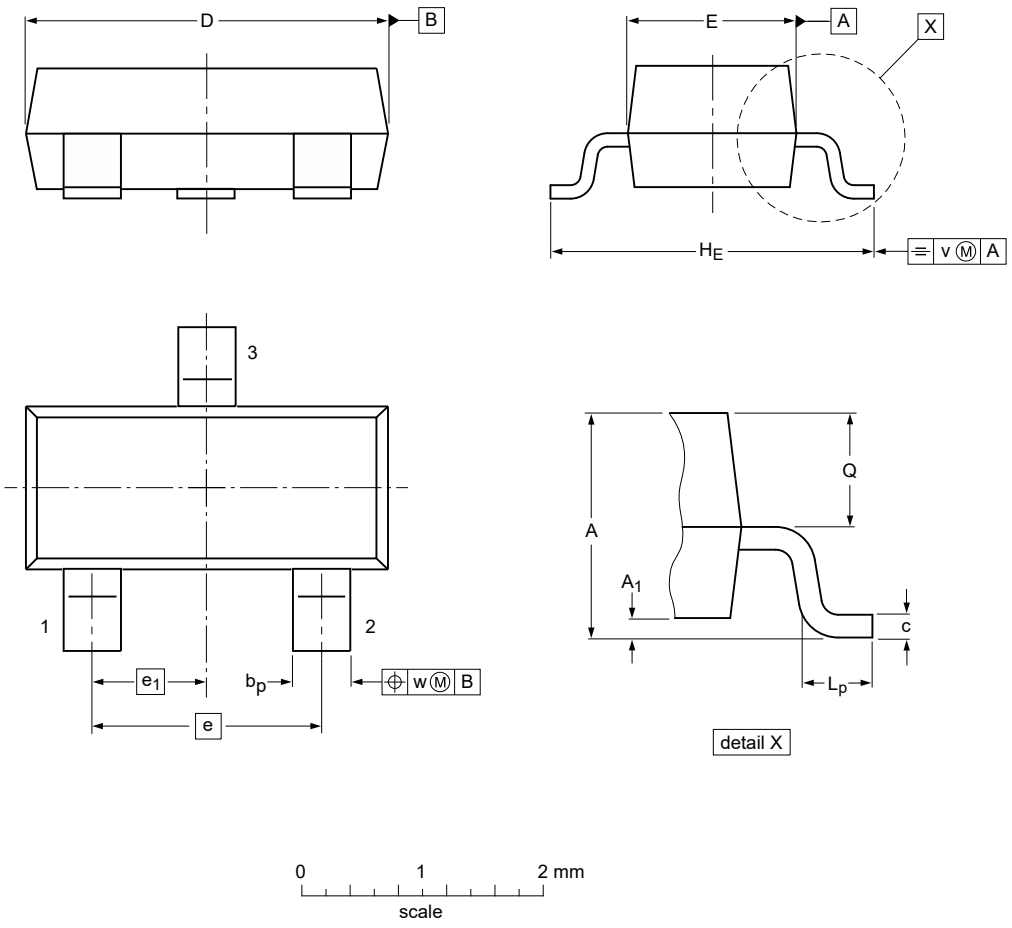
11. Test information

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.

12. Package outline

Plastic surface-mounted package; 3 leads **SOT23**



Dimensions (mm are the original dimensions)

Unit		A	A_1	b_p	c	D	E	e	e_1	H_E	L_p	Q	v	w
mm	max	1.1	0.1	0.48	0.15	3.0	1.4			2.5	0.45	0.55		
	nom							1.9	0.95				0.2	0.1
	min	0.9		0.38	0.09	2.8	1.2			2.1	0.15	0.45		

sot023_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT23		TO-236AB				~~14-06-19~~ 14-09-22

Fig. 16. Package outline SOT23

13. Soldering

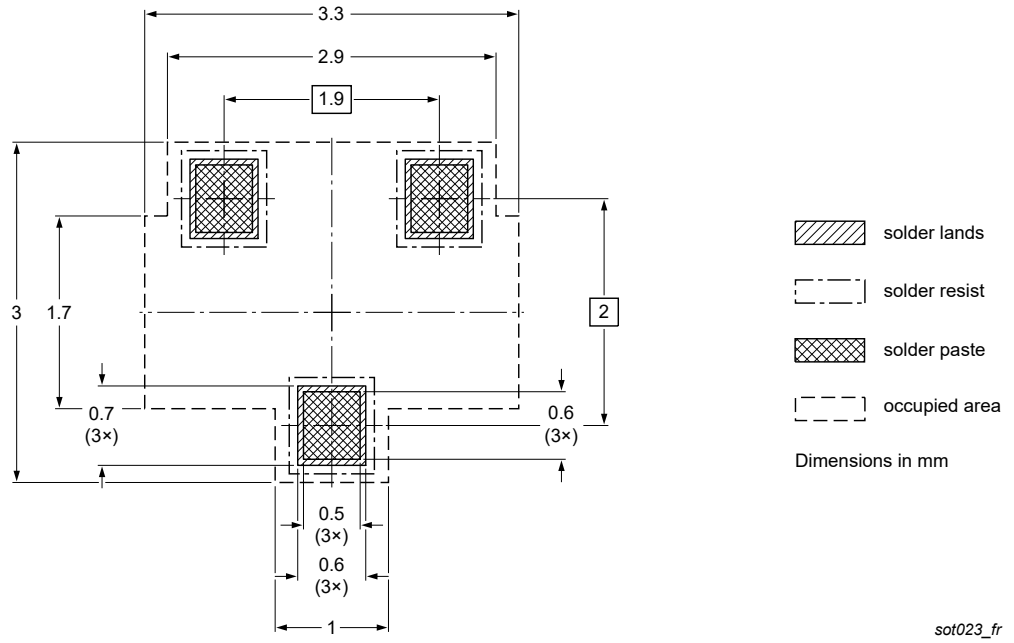


Fig. 17. Reflow soldering footprint for SOT23

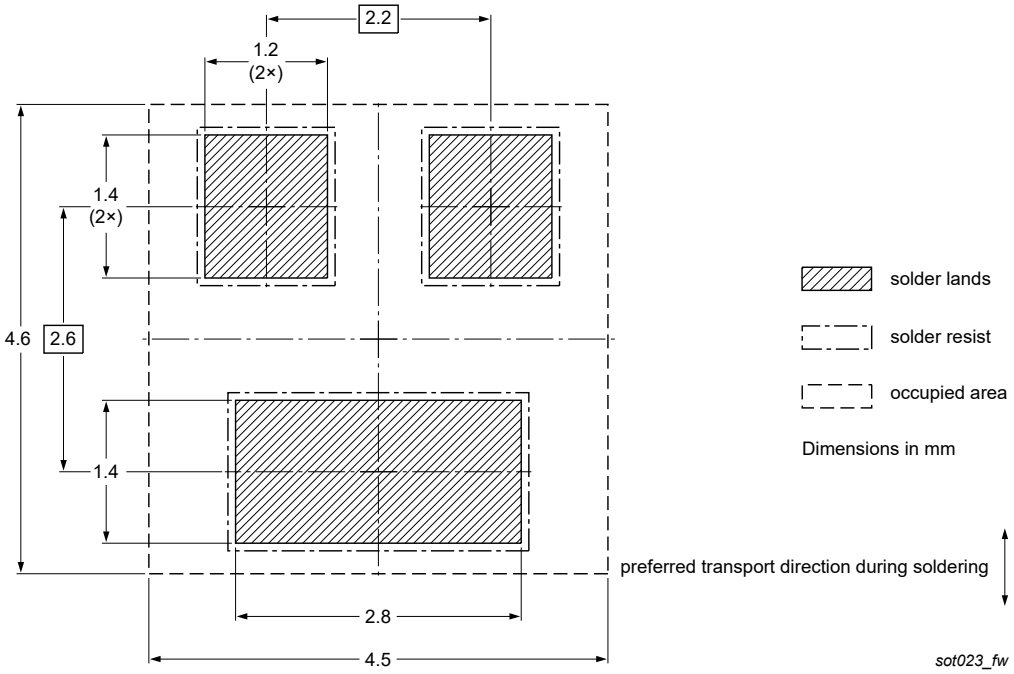


Fig. 18. Wave soldering footprint for SOT23

14. Revision history

Table 7. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
MMBZ16VAL-Q v.1	20221004	Product data sheet	-	-

15. Legal information

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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