



# NUP1301QA

## Ultra low capacitance ESD protection array

13 November 2017

Product data sheet

## 1. General description

Ultra low capacitance ElectroStatic Discharge (ESD) protection array in a leadless ultra small DFN1010D-3 (SOT1215) Surface-Mounted Device (SMD) plastic package with visible and solderable side pads, designed to protect one signal line in rail-to-rail configuration from the damage caused by ESD and other transients.

## 2. Features and benefits

- ESD protection of one signal line (rail-to-rail configuration)
- Ultra low diode capacitance:  $C_d = 2.3 \text{ pF}$
- Very low reverse leakage current:  $\leq 30 \text{ nA}$
- ESD protection up to 30 kV
- ESD robustness exceeds IEC 61000-4-2; level 4 (ESD)
- IEC 61000-4-5 (surge);  $I_{PP} = 11 \text{ A}$  at  $t_p = 8/20 \text{ }\mu\text{s}$
- AEC-Q101 qualified

## 3. Applications

- Telecommunication networks
- Video line protection
- Microcontroller protection
- I<sup>2</sup>C-bus protection
- Antenna power supply
- Analog audio
- Class-D amplifier

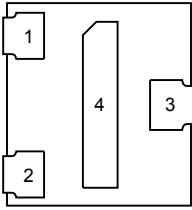
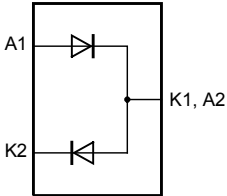
## 4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Per diode</b>						
$V_R$	reverse voltage	$T_{amb} = 25 \text{ }^\circ\text{C}$	-	-	80	V
$I_R$	reverse current	$V_R = 25 \text{ V}; T_{amb} = 25 \text{ }^\circ\text{C}$	-	7	30	nA
		$V_R = 80 \text{ V}; T_{amb} = 25 \text{ }^\circ\text{C}$	-	50	500	nA
$C_d$	diode capacitance	$f = 1 \text{ MHz}; V_R = 0 \text{ V}; T_{amb} = 25 \text{ }^\circ\text{C};$ Pin 1 - pin 3	-	0.5	0.75	pF
		$f = 1 \text{ MHz}; V_R = 0 \text{ V}; T_{amb} = 25 \text{ }^\circ\text{C};$ Pin 2 - pin 3	-	1.8	2	pF
		$f = 1 \text{ MHz}; V_R = 0 \text{ V}; T_{amb} = 25 \text{ }^\circ\text{C};$ Pin 3 - pins 1 and 2	-	2.3	2.75	pF

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	A1	anode (diode 1)	 <p>Transparent top view <b>DFN1010D-3 (SOT1215)</b></p>	 <p>aaa-022858</p>
2	K2	cathode (diode 2)		
3	K1, A2	cathode (diode 1) and anode (diode 2)		
4	K1, A2	cathode (diode1) and anode (diode2)		

6. Ordering information

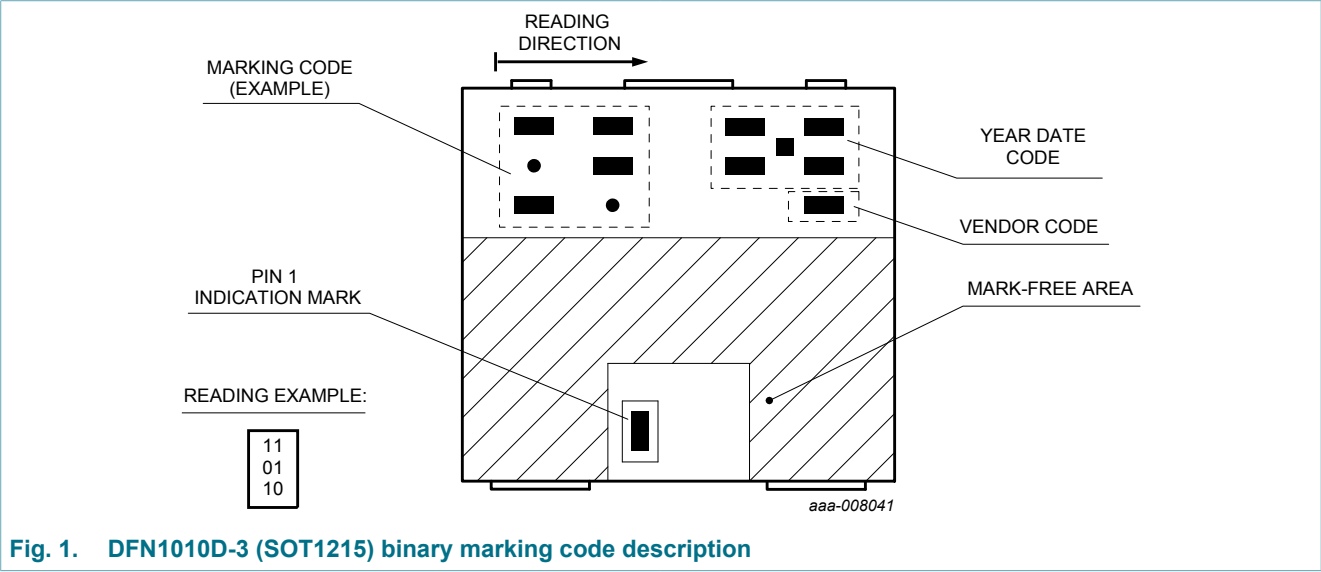
Table 3. Ordering information

Type number	Package		
	Name	Description	Version
NUP1301QA	DFN1010D-3	DFN1010D-3: plastic thermal enhanced ultra thin small outline package; no leads; 3 terminals; body 1.1 x 1.0 x 0.37 mm	SOT1215

7. Marking

Table 4. Marking codes

Type number	Marking code
NUP1301QA	X 110



## 8. Limiting values

**Table 5. Limiting values**

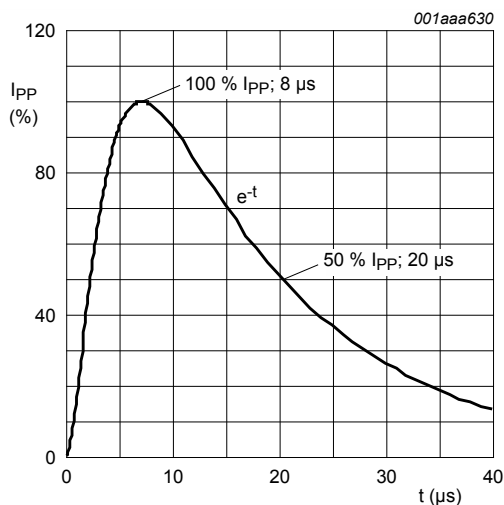
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions		Min	Max	Unit
Per diode						
V <sub>R</sub>	reverse voltage	T <sub>amb</sub> = 25 °C		-	80	V
I <sub>F</sub>	forward current	pulsed; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02 ; single diode loaded; T <sub>amb</sub> = 25 °C		-	290	mA
		pulsed; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02 ; double diode loaded; T <sub>amb</sub> = 25 °C		-	170	mA
I <sub>FRM</sub>	repetitive peak forward current	t <sub>p</sub> ≤ 500 μs; δ ≤ 0.25 ; T <sub>j</sub> = 25 °C		-	700	mA
I <sub>FSM</sub>	non-repetitive peak forward current	square wave; t <sub>p</sub> = 100 μs		-	4	A
		square wave; t <sub>p</sub> = 1 ms		-	1.5	A
		square wave; t <sub>p</sub> = 1 s		-	0.5	A
Per device						
I <sub>PPM</sub>	rated peak pulse current	t <sub>p</sub> = 8/20 μs	<a href="#">[1]</a> <a href="#">[2]</a>	-	11	A
T <sub>j</sub>	junction temperature			-	150	°C
T <sub>amb</sub>	ambient temperature			-55	150	°C
T <sub>stg</sub>	storage temperature			-65	150	°C
ESD maximum ratings						
V <sub>ESD</sub>	electrostatic discharge voltage	IEC 61000-4-2 (contact discharge)	<a href="#">[2]</a> <a href="#">[3]</a>	-	30	kV

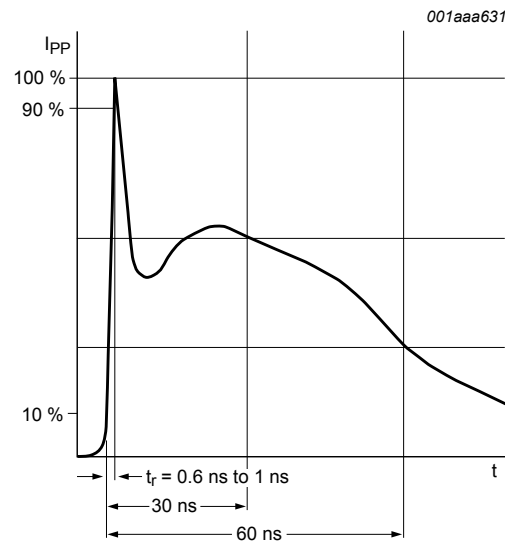
[1] Non-repetitive current pulse 8/20  $\mu\text{s}$  exponential decay waveform according to IEC 61000-4-5.

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

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



**Fig. 2. 8/20  $\mu\text{s}$  pulse waveform according to IEC 61000-4-5**



**Fig. 3. ESD pulse waveform according to IEC 61000-4-2**

## 9. Characteristics

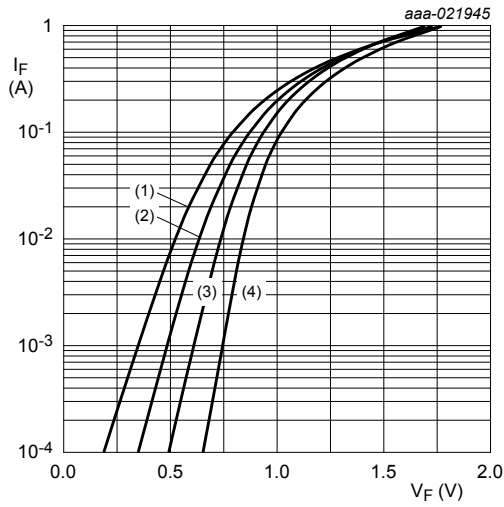
Table 6. Characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Per diode							
V <sub>BR</sub>	breakdown voltage	I <sub>R</sub> = 0.1 mA; T <sub>amb</sub> = 25 °C		100	-	-	V
V <sub>F</sub>	forward voltage	I <sub>F</sub> = 1 mA; T <sub>amb</sub> = 25 °C	[1]	-	-	715	mV
		I <sub>F</sub> = 10 mA; T <sub>amb</sub> = 25 °C	[1]	-	-	855	mV
		I <sub>F</sub> = 50 mA; T <sub>amb</sub> = 25 °C; Pulse	[1]	-	-	1	V
		I <sub>F</sub> = 150 mA; T <sub>amb</sub> = 25 °C	[1]	-	-	1.25	V
I <sub>R</sub>	reverse current	V <sub>R</sub> = 25 V; T <sub>amb</sub> = 25 °C		-	7	30	nA
		V <sub>R</sub> = 80 V; T <sub>amb</sub> = 25 °C		-	50	500	nA
		V <sub>R</sub> = 25 V; T <sub>j</sub> = 150 °C		-	-	30	μA
		V <sub>R</sub> = 80 V; T <sub>j</sub> = 150 °C		-	-	150	μA
C <sub>d</sub>	diode capacitance	f = 1 MHz; V <sub>R</sub> = 0 V; T <sub>amb</sub> = 25 °C; Pin 1 - pin 3		-	0.5	0.75	pF
		f = 1 MHz; V <sub>R</sub> = 0 V; T <sub>amb</sub> = 25 °C; Pin 2 - pin 3		-	1.8	2	pF
		f = 1 MHz; V <sub>R</sub> = 0 V; T <sub>amb</sub> = 25 °C; Pin 3 - pins 1 and 2		-	2.3	2.75	pF
R <sub>dyn</sub>	dynamic resistance	TLP = 10 A; positive; T <sub>amb</sub> = 25 °C		-	0.55	-	Ω
		TLP = 10 A; negative; T <sub>amb</sub> = 25 °C		-	0.3	-	Ω
Per device							
V <sub>CL</sub>	clamping voltage	I <sub>PP</sub> = 1 A; T <sub>amb</sub> = 25 °C	[2] [3]	-	-	3	V
		I <sub>PP</sub> = 11 A; T <sub>amb</sub> = 25 °C	[2] [3]	-	-	10	V

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

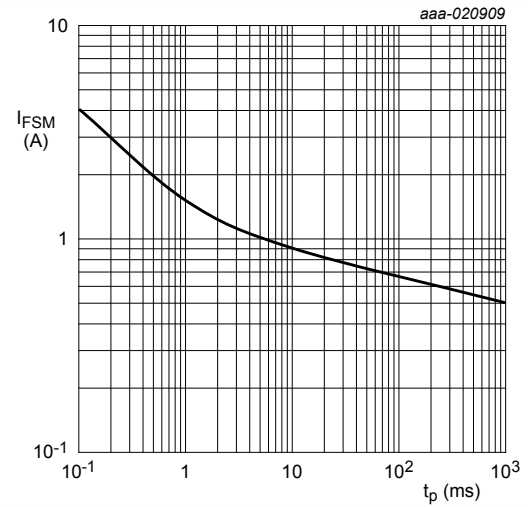
[2] Non-repetitive current pulse 8/20  $\mu\text{s}$  exponential decay waveform according to IEC 61000-4-5.

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



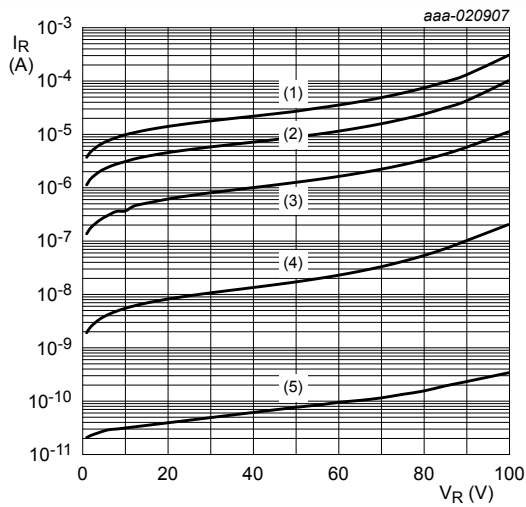
- (1)  $T_j = 150\text{ }^{\circ}\text{C}$
- (2)  $T_j = 85\text{ }^{\circ}\text{C}$
- (3)  $T_j = 25\text{ }^{\circ}\text{C}$
- (4)  $T_j = -40\text{ }^{\circ}\text{C}$

**Fig. 4. Forward current as a function of forward voltage; typical values**



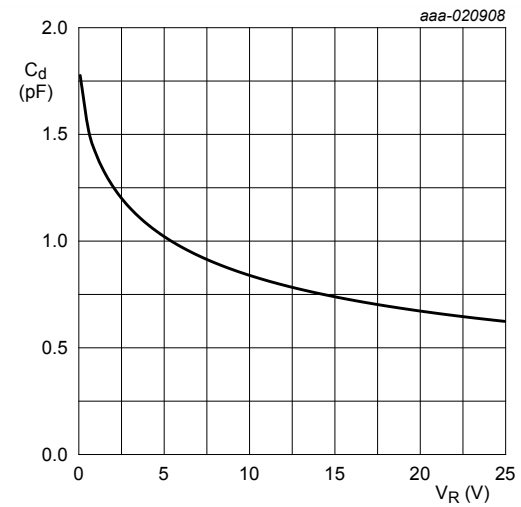
Based on square wave currents.  
 $T_{\text{amb}} = 25\text{ }^{\circ}\text{C}$

**Fig. 5. Non-repetitive forward current as a function of pulse duration; maximum values**



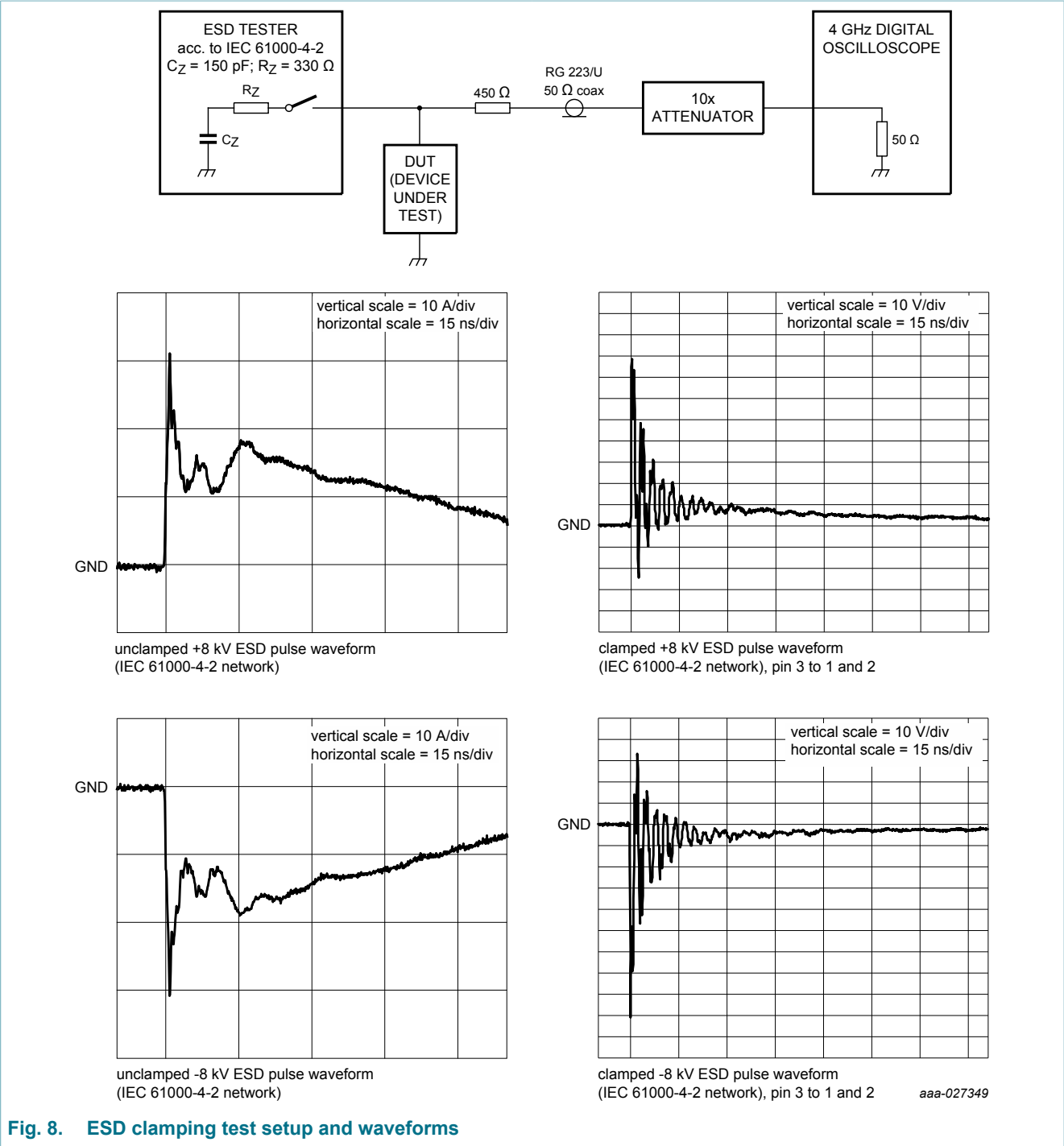
- (1)  $T_j = 150\text{ }^{\circ}\text{C}$
- (2)  $T_j = 125\text{ }^{\circ}\text{C}$
- (3)  $T_j = 85\text{ }^{\circ}\text{C}$
- (4)  $T_j = 25\text{ }^{\circ}\text{C}$
- (5)  $T_j = -40\text{ }^{\circ}\text{C}$

**Fig. 6. Reverse current as a function of reverse voltage; typical values**



$f = 1\text{ MHz}$ ;  $T_{\text{amb}} = 25\text{ }^{\circ}\text{C}$ ; pin 2 to GND

**Fig. 7. Diode capacitance as a function of reverse voltage; typical values**



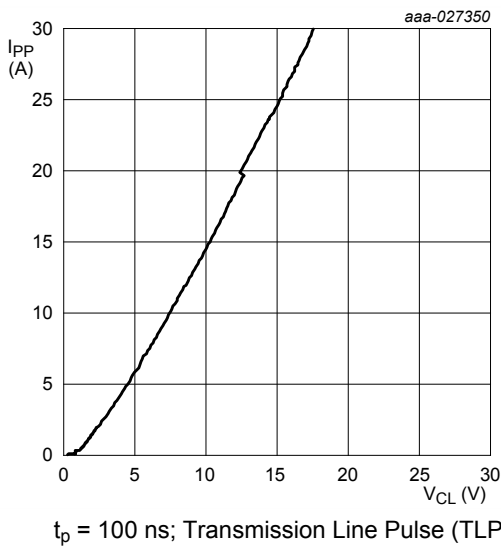


Fig. 9. Positive clamping voltage (TLP); typical values

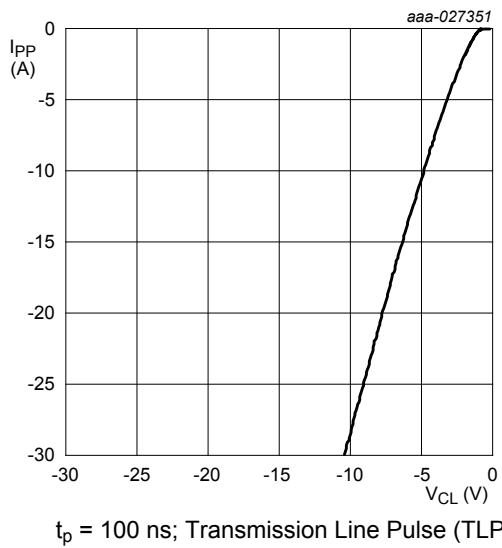


Fig. 10. Negative clamping voltage (TLP); typical values

## 10. 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.

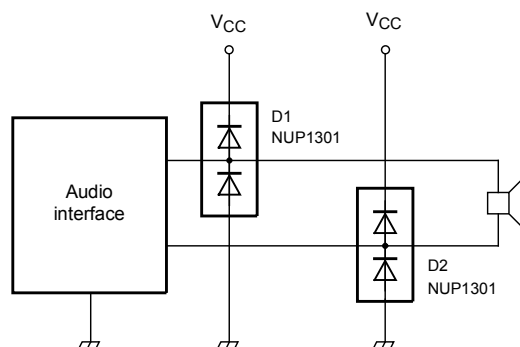


Fig. 11. Typical application for the protection of one signal line

### 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 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

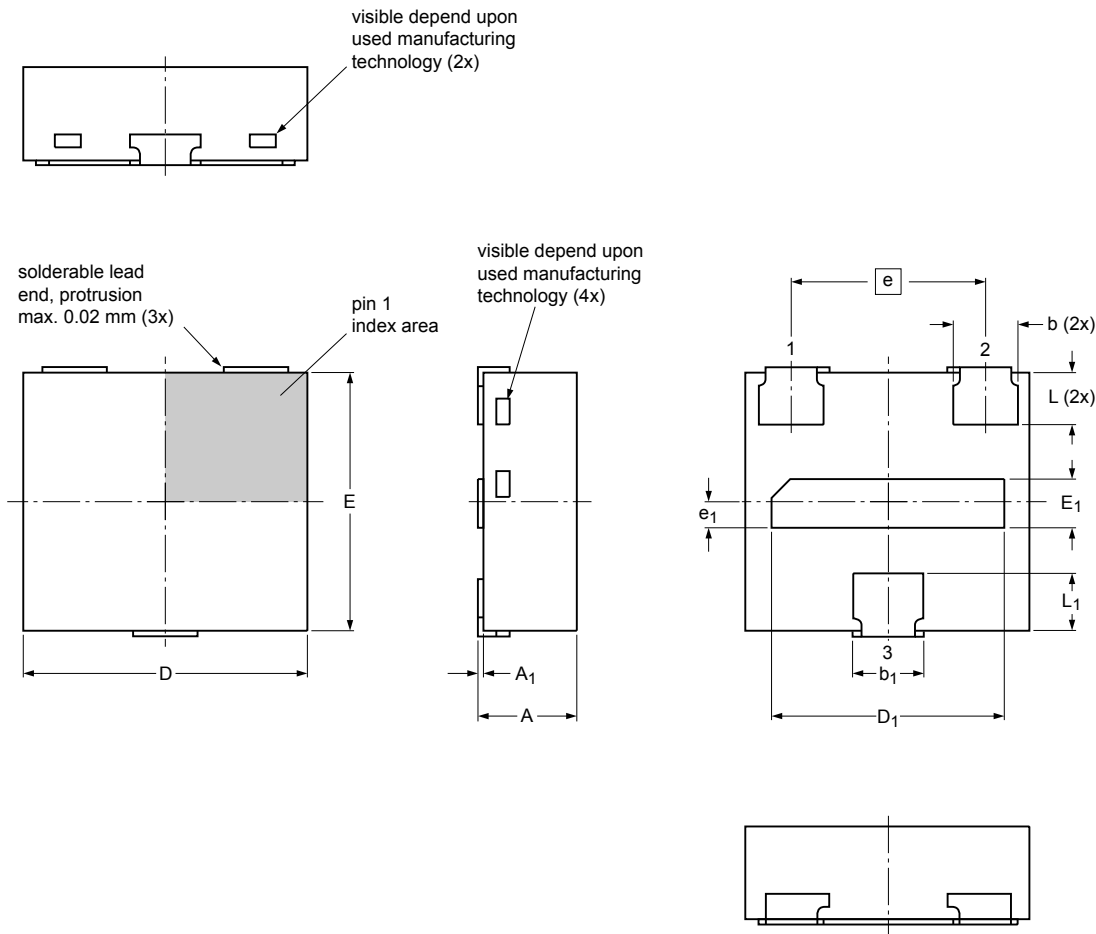
This product has been qualified in accordance with the Automotive Electronics Council (AEC) standard Q101 - *Stress test qualification for discrete semiconductors*, and is suitable for use in automotive applications.



12. Package outline

DFN1010D-3: plastic thermal enhanced ultra thin small outline package; no leads;  
3 terminals; body: 1.1 x 1.0 x 0.37 mm

SOT1215



0 1 mm

scale

Dimensions (mm are the original dimensions)

Unit	A	A <sub>1</sub>	b	b <sub>1</sub>	D	D <sub>1</sub>	E	E <sub>1</sub>	e	e <sub>1</sub>	L	L <sub>1</sub>
min	0.34		0.22	0.245	1.05	0.87	0.95	0.16			0.17	0.195
mm	nom		0.25	0.275	1.10	0.90	1.00	0.19	0.75	0.1	0.20	0.225
	max	0.40	0.30	0.325	1.15	0.95	1.05	0.24			0.25	0.275

Note  
1. Dimension A is including plating thickness.

sot1215\_po

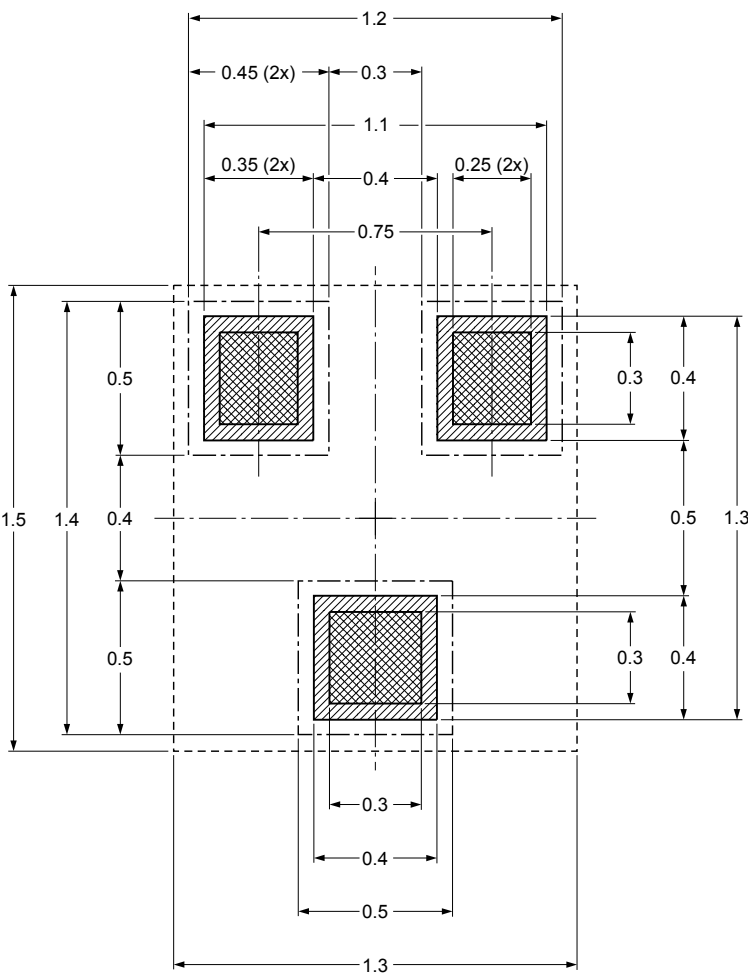
Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT1215						-13-03-05- 13-03-06





Fig. 12. Package outline DFN1010D-3 (SOT1215)

13. Soldering

Footprint information for reflow soldering of DFN1010D-3 package

SOT1215



-  solder land
-  solder land plus solder paste
-  occupied area
-  solder resist

Dimensions in mm

Issue date ~~12-11-23~~  
13-03-06

sot1215\_fr

Fig. 13. Reflow soldering footprint for DFN1010D-3 (SOT1215)

14. Revision history

Table 7. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
NUP1301QA v.1	20171113	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.
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Date of release: 13 November 2017



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