

NUP1301U-Q

Ultra low capacitance ESD protection array

6 May 2022

Product data sheet

1. General description

Ultra low capacitance ElectroStatic Discharge (ESD) protection array in a small SOT323 (SC-70) 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.

2. Features and benefits

- ESD protection of one signal line (rail-to-rail configuration)
- Ultra low diode capacitance: C_d = 0.6 pF
- ESD protection up to 30 kV
- IEC 61000-4-2; level 4 (ESD)
- IEC 61000-4-5 (surge); I_{PP} = 11 A
- Qualified according to AEC-Q101 and recommended for use in automotive applications

3. Applications

- Telecommunication networks
- Video line protection
- Microcontroller protection
- I²C-bus protection
- Antenna power supply
- Analog audio
- Class-D amplifier

4. Quick reference data

Table 1. Quick reference data

| Symbol | Parameter | Conditions | | Min | Тур | Max | Unit |
|------------------|------------------------------------|---|--|-----|-----|------|------|
| V _{RRM} | repetitive peak reverse voltage | | | - | - | 80 | V |
| C _d | diode capacitance | f = 1 MHz; V _R = 0 V; T _{amb} = 25 °C | | - | 0.6 | 0.75 | pF |
| I _R | reverse current | V _R = 80 V; T _{amb} = 25 °C | | - | - | 100 | nA |

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5. Pinning information

| Pin | Symbol | Description | Simplified outline | Graphic symbol |
|-----|-----------------|----------------|-----------------------|--------------------|
| 1 | GND | ground | 3 | K1, A2 |
| 2 | V _{CC} | supply voltage | | |
| 3 | I/O | input/output | 1 2 SC-70 (SOT323) | A1 K2 006aaa763 |

6. Ordering information

Table 3. Ordering information

| Type number | Package | | | | |
|-------------|---------|--|---------|--|--|
| | Name | Description | Version | | |
| NUP1301U-Q | | plastic, surface-mounted package; 3 leads; 1.3 mm pitch; 2 mm x 1.25 mm x 0.95 mm body | SOT323 | | |

7. Marking

Table 4. Marking codes

| Type number | Marking code[1] |
|-------------|-----------------|
| NUP1301U-Q | %VU |

[1] % = placeholder for manufacturing site code

8. Limiting values

Table 5. Limiting values

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

| Symbol | Parameter | Conditions | | Min | Мах | Unit |
|------------------|---------------------------------|------------------------------------|---------|-----|-----|------|
| V _{RRM} | repetitive peak reverse voltage | | | - | 80 | V |
| V _R | reverse voltage | | | - | 80 | V |
| l _F | forward current | | [1] | - | 215 | mA |
| I _{FRM} | repetitive peak forward current | t _p ≤ 1 ms; δ ≤ 0.25 | | - | 500 | mA |
| P _{PPM} | rated peak pulse power | t _p = 8/20 μs | [2] [3] | - | 220 | W |
| I _{PPM} | rated peak pulse current | 1 | [2] [3] | - | 11 | А |
| I _{FSM} | non-repetitive peak | square wave; t _p = 1 μs | [4] | - | 4 | А |
| | forward current | square wave; t _p = 1 ms | [4] | - | 1 | А |
| | | square wave; t _p = 1 s | [4] | - | 0.5 | А |
| P _{tot} | total power dissipation | T _{amb} ≤ 25 °C | [5] [6] | - | 200 | mW |
| Tj | junction temperature | | | - | 150 | °C |
| T _{amb} | ambient temperature | | | -55 | 150 | °C |
| T _{stg} | storage temperature | | | -65 | 150 | °C |
| ESD maximu | um ratings | | | | | |
| V _{ESD} | electrostatic discharge | IEC 61000-4-2 (contact discharge) | [3] [7] | - | 30 | kV |
| | voltage | machine model | | - | 400 | V |
| | | MIL-STD-883 (human body model) | | - | 10 | kV |

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

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

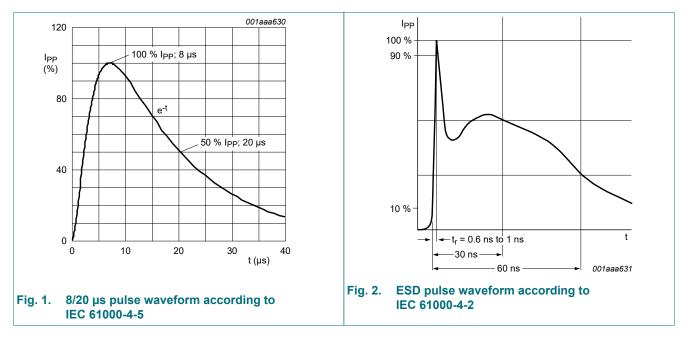
[3] Measured from pin 3 to pins 1 and 2 (pins 1 and 2 are connected).

[4] $T_j = 25 \degree C$ prior to surge.

[5] Single diode loaded.

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

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



9. Thermal characteristics

| Symbol | Parameter | Conditions | | Min | Тур | Мах | Unit |
|-----------------------|--|-------------|---------|-----|-----|-----|------|
| R _{th(j-a)} | thermal resistance from junction to ambient | in free air | [1] [2] | - | - | 625 | K/W |
| R _{th(j-sp)} | thermal resistance from junction to solder point | | | - | - | 300 | K/W |

Single diode loaded. [1]

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

10. Characteristics

Table 7. Characteristics

| Symbol | Parameter | Conditions | | Min | Тур | Max | Unit |
|-----------------|-------------------|---|---------|-----|-----|------|------|
| V _F | forward voltage | I _F = 1 mA; T _{amb} = 25 °C | [1] | - | - | 715 | mV |
| | | I _F = 10 mA; T _{amb} = 25 °C | [1] | - | - | 855 | mV |
| | | I _F = 50 mA; T _{amb} = 25 °C | [1] | - | - | 1 | V |
| | | I _F = 150 mA; T _{amb} = 25 °C | [1] | - | - | 1.25 | V |
| V _{BR} | breakdown voltage | I _R = 100 μA; T _{amb} = 25 °C | | 100 | - | - | V |
| I _R | reverse current | V _R = 25 V; T _{amb} = 25 °C | | - | - | 30 | nA |
| | | V _R = 80 V; T _{amb} = 25 °C | | - | - | 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; T _{amb} = 25 °C | | - | 0.6 | 0.75 | pF |
| V _{CL} | clamping voltage | I _{PP} = 1 A; T _{amb} = 25 °C | [2] [3] | - | - | 3 | V |
| | | I _{PPM} = 11 A; T _{amb} = 25 °C | [2] [3] | - | - | 20 | V |

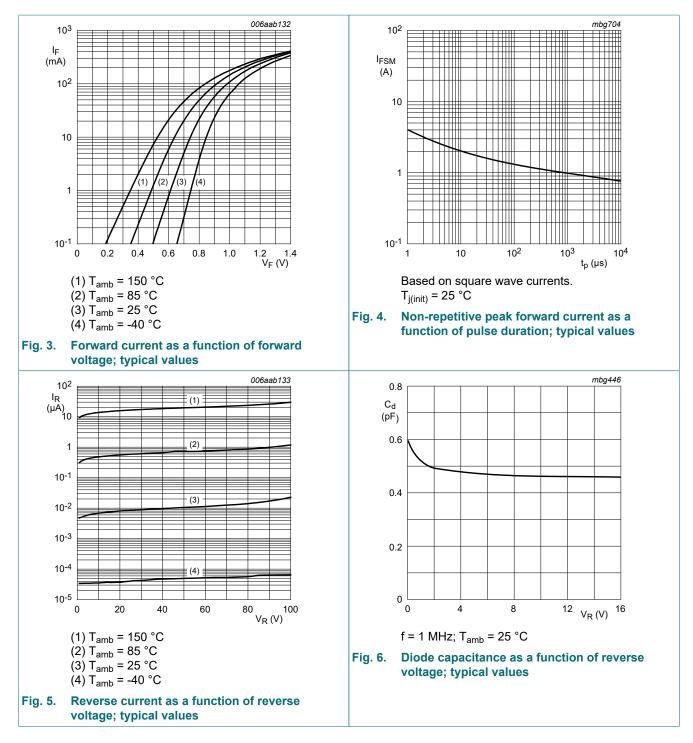
[1]

Pulse test: t_p ≤ 300 µs; δ ≤ 0.02. Non-repetitive current pulse 8/20 µs exponential decay waveform according to IEC 61000-4-5. [2] [3]

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

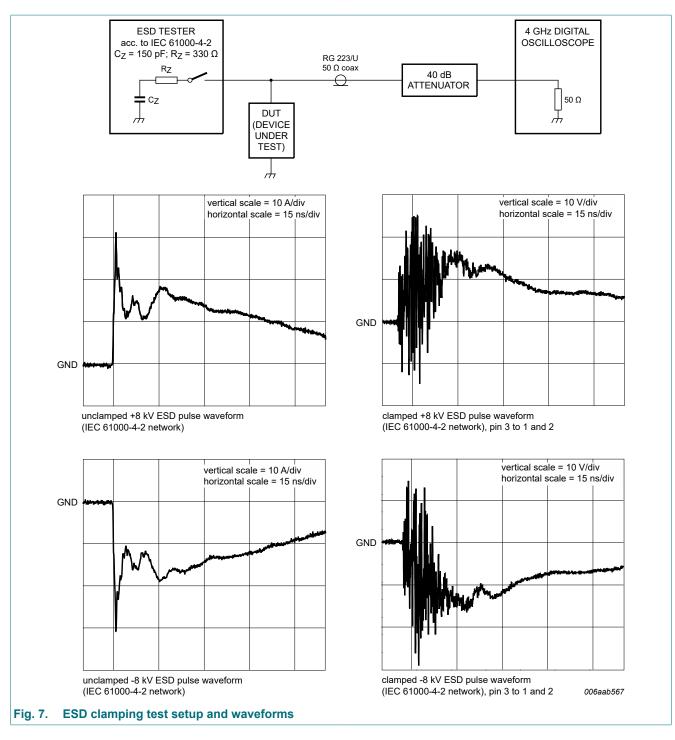
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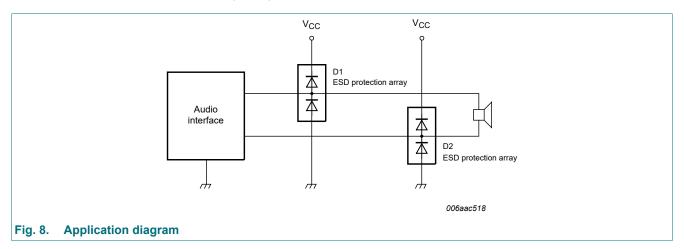
Ultra low capacitance ESD protection array



11. 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.



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:

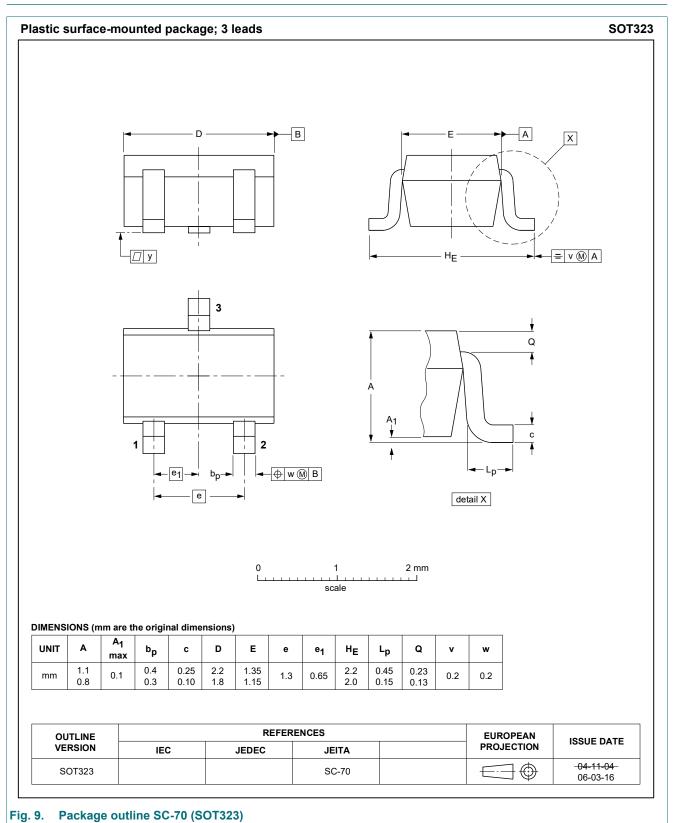
- 1. Place the device as close to the input terminal or connector as possible.
- 2. Minimize the path length between the device and the protected line.
- **3.** Keep parallel signal paths to a minimum.
- 4. Avoid running protected conductors in parallel with unprotected conductors.
- 5. Minimize all 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.

12. Test information

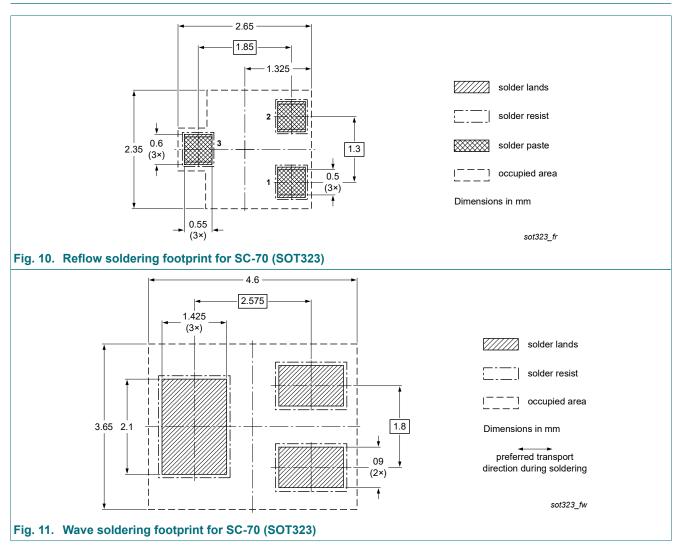
Quality information

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.

13. Package outline



14. Soldering



Product data sheet

15. Revision history

| Table 8. Revision history | | | | | | |
|---------------------------|--------------|--------------------|---------------|------------|--|--|
| Data sheet ID | Release date | Data sheet status | Change notice | Supersedes | | |
| NUP1301U-Q v.1 | 20220506 | Product data sheet | - | - | | |

16. 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. |

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

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