

# Protection Device

TVS (Transient Voltage Suppressor)

## ESD311-U1-02N

Uni-directional, 15 V, 210 pF, 0603, RoHS and Halogen Free compliant

ESD311-U1-02N

## Data Sheet

Revision 1.0, 2014-05-28  
Final

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## 1 Product Overview

### 1.1 Features

- ESD / Transient / Surge protection according to:
  - IEC61000-4-2 (ESD):  $\pm 30$  kV (air / contact discharge)
  - IEC61000-4-4 (EFT):  $\pm 4$  kV /  $\pm 80$  A (5/50 ns)
  - IEC61000-4-5 (surge):  $\pm 28$  A (8/20  $\mu$ s)
- Uni-directional working voltage up to  $V_{RWM} = 15$  V
- Low capacitance:  $C_L = 210$  pF (typical)
- Low clamping voltage  $V_{CL} = 29$  V (typical) at  $I_{PP} = 28$  A
- Low reverse current.  $I_R < 1$  nA (typical)
- Small and flat-profile SMD plastic package: 1.6 mm x 0.8 mm x 0.375 mm.
- Pb-free (RoHS compliant) and halogen free package



### 1.2 Application Examples

- Surge protection of USB  $V_{BUS}$  lines in mobile devices

### 1.3 Product Description

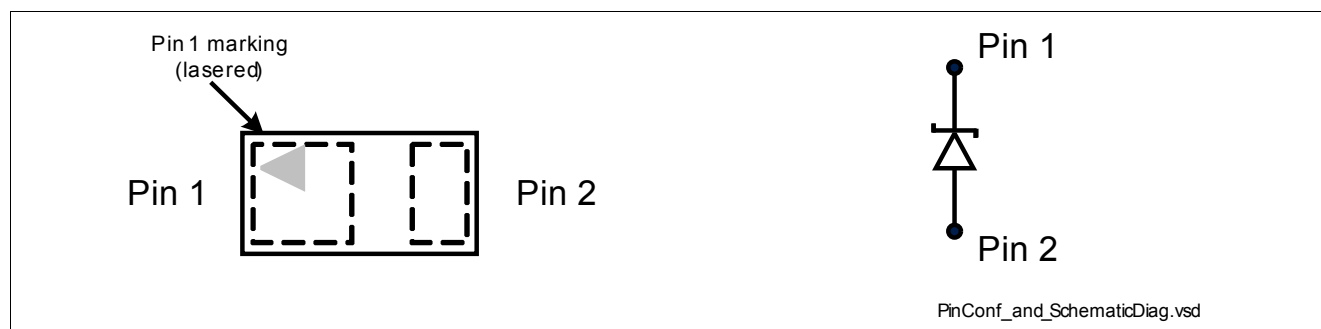


Figure 1-1 Pin Configuration and Schematic Diagram (in mm)

Table 1-1 Part Information

| Type          | Package  | Configuration   | Marking code |
|---------------|----------|-----------------|--------------|
| ESD311-U1-02N | TSNP-2-2 | uni-directional | A            |

## 2 Maximum Ratings

**Table 2-1** Maximum Ratings at  $T_A = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified

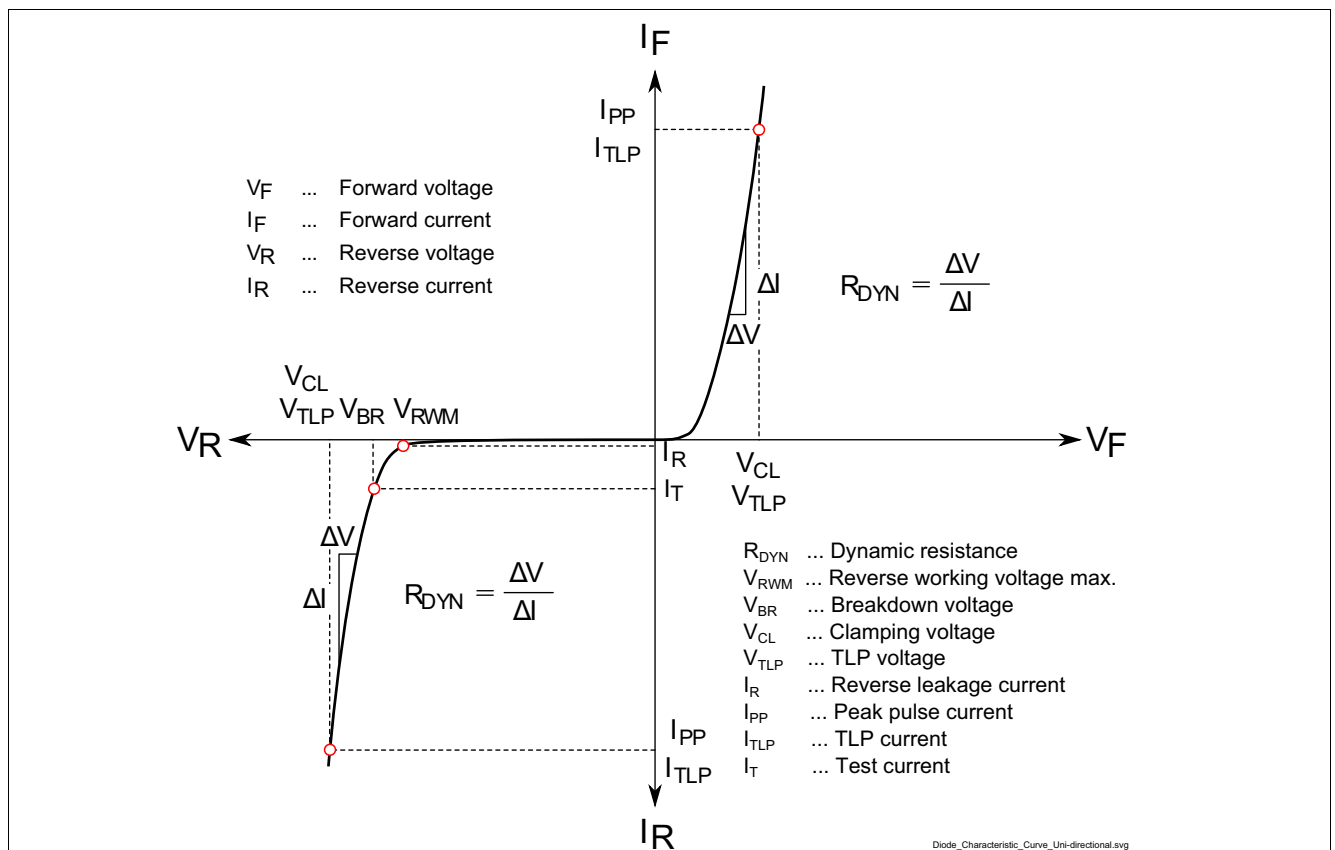
| Parameter                                 | Symbol           | Values     | Unit               |
|-------------------------------------------|------------------|------------|--------------------|
| ESD air / contact discharge <sup>1)</sup> | $V_{\text{ESD}}$ | $\pm 30$   | kV                 |
| Peak pulse power <sup>2)</sup>            | $P_{\text{PK}}$  | 800        | W                  |
| Peak pulse current <sup>2)</sup>          | $I_{\text{PP}}$  | 28         | A                  |
| Operating temperature range               | $T_{\text{OP}}$  | -40 to 125 | $^{\circ}\text{C}$ |
| Storage temperature                       | $T_{\text{stg}}$ | -65 to 150 | $^{\circ}\text{C}$ |

1)  $V_{\text{ESD}}$  according to IEC61000-4-2

2) Non-repetitive current pulse 8/20 $\mu\text{s}$  exponential decay waveform according to IEC61000-4-5

**Attention:** Stresses above the max. values listed here may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. Maximum ratings are absolute ratings; exceeding only one of these values may cause irreversible damage to the integrated circuit.

## 3 Electrical Characteristics



**Figure 3-1** Definitions of electrical characteristics

## Electrical Characteristics

**Table 3-1 DC Characteristics at  $T_A = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified**

| Parameter               | Symbol    | Values |      |      | Unit | Note / Test Condition |
|-------------------------|-----------|--------|------|------|------|-----------------------|
|                         |           | Min.   | Typ. | Max. |      |                       |
| Reverse working voltage | $V_{RWM}$ | –      | –    | 15   | V    |                       |
| Breakdown voltage       | $V_{BR}$  | 16     | 17   | –    | V    | $I_T = 1\text{ mA}$   |
| Reverse current         | $I_R$     | –      | <1   | 100  | nA   | $V_R = 15\text{ V}$   |

**Table 3-2 AC Characteristics at  $T_A = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified**

| Parameter        | Symbol | Values |      |      | Unit | Note / Test Condition                   |
|------------------|--------|--------|------|------|------|-----------------------------------------|
|                  |        | Min.   | Typ. | Max. |      |                                         |
| Line capacitance | $C_L$  | –      | 210  | 290  | pF   | $V_R = 0\text{ V}$ , $f = 1\text{ MHz}$ |

**Table 3-3 ESD and Surge Characteristics at  $T_A = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified**

| Parameter                        | Symbol           | Values |      |      | Unit | Note / Test Condition                            |
|----------------------------------|------------------|--------|------|------|------|--------------------------------------------------|
|                                  |                  | Min.   | Typ. | Max. |      |                                                  |
| Clamping voltage <sup>1)</sup>   | V <sub>CL</sub>  | —      | 22   | 26.5 | V    | I <sub>TLP</sub> = 16 A, t <sub>p</sub> = 100 ns |
|                                  |                  | —      | 23   | 28   |      | I <sub>TLP</sub> = 30 A, t <sub>p</sub> = 100 ns |
| Clamping voltage <sup>2)</sup>   |                  | —      | 21   | 25.5 |      | I <sub>PP</sub> = 1 A, t <sub>p</sub> = 8/20 μs  |
|                                  |                  | —      | 29   | 35   |      | I <sub>PP</sub> = 28 A, t <sub>p</sub> = 8/20 μs |
| Dynamic resistance <sup>1)</sup> | R <sub>DYN</sub> | —      | 0.07 | —    | Ω    | t <sub>p</sub> = 100 ns                          |

1) Please refer to Application Note AN210[1]. TLP parameter:  $Z_0 = 50\text{ }\Omega$ ,  $t_p = 100\text{ ns}$ ,  $t_r = 600\text{ ps}$ .

2) Non-repetitive current pulse 8/20 $\mu\text{s}$  exponential decay waveform according to IEC61000-4-5

## 4 Typical Characteristics Diagrams

Typical characteristics diagrams at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

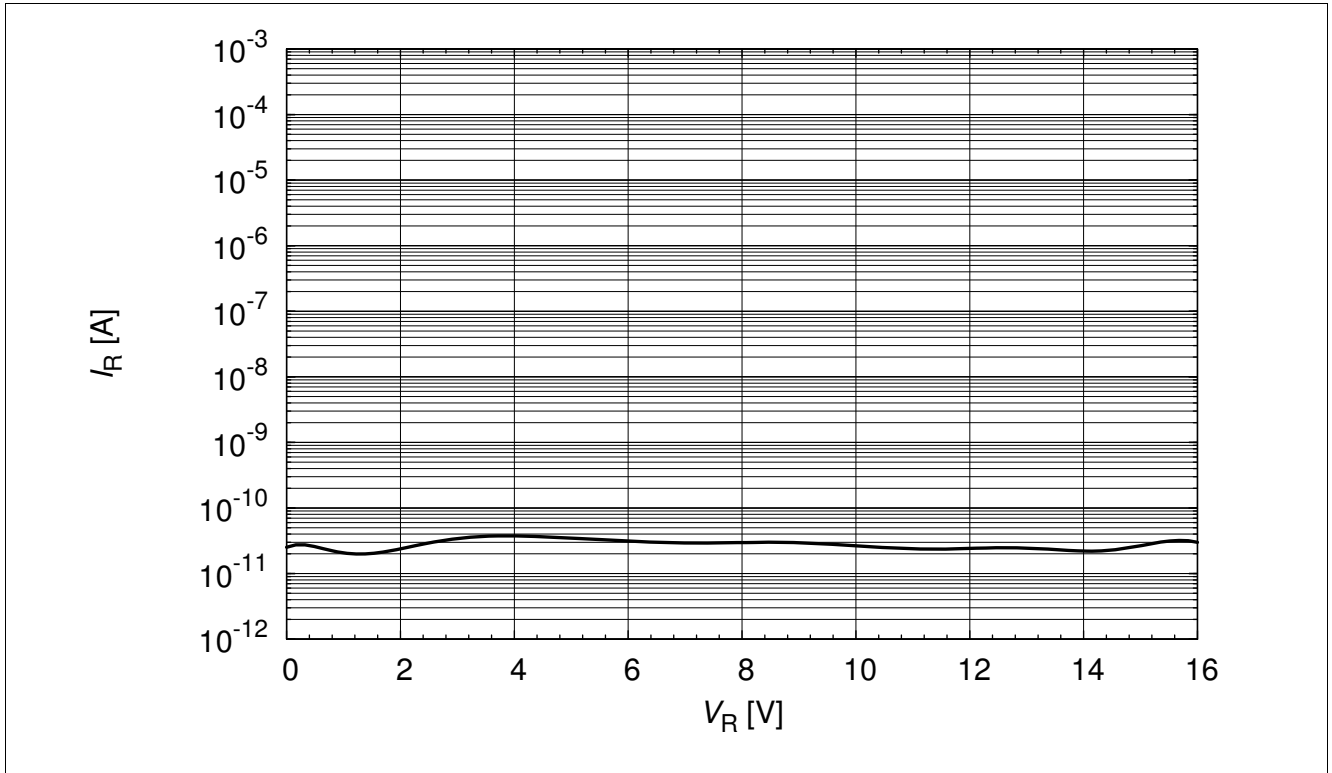


Figure 4-1 Reverse leakage current:  $I_R = f(V_R)$

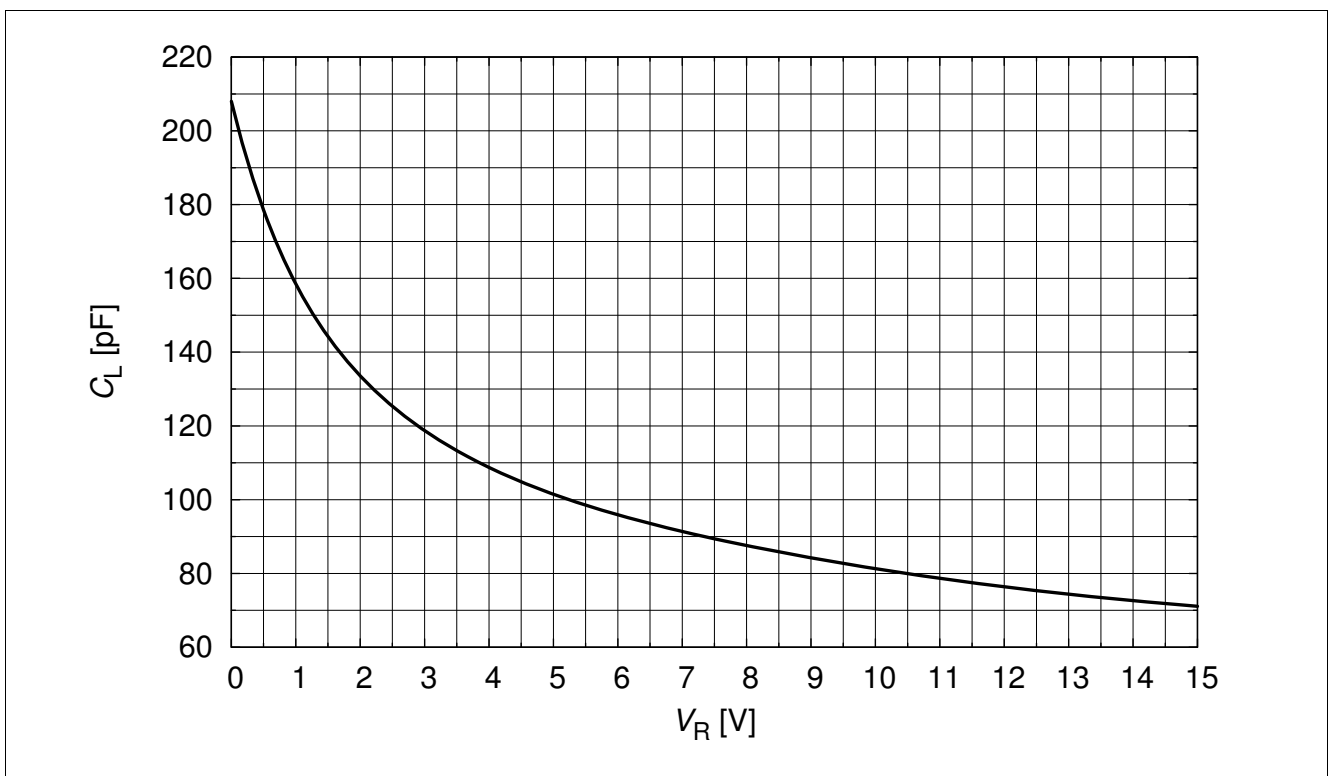


Figure 4-2 Line capacitance:  $C_L = f(V_R)$

# Typical Characteristics Diagrams

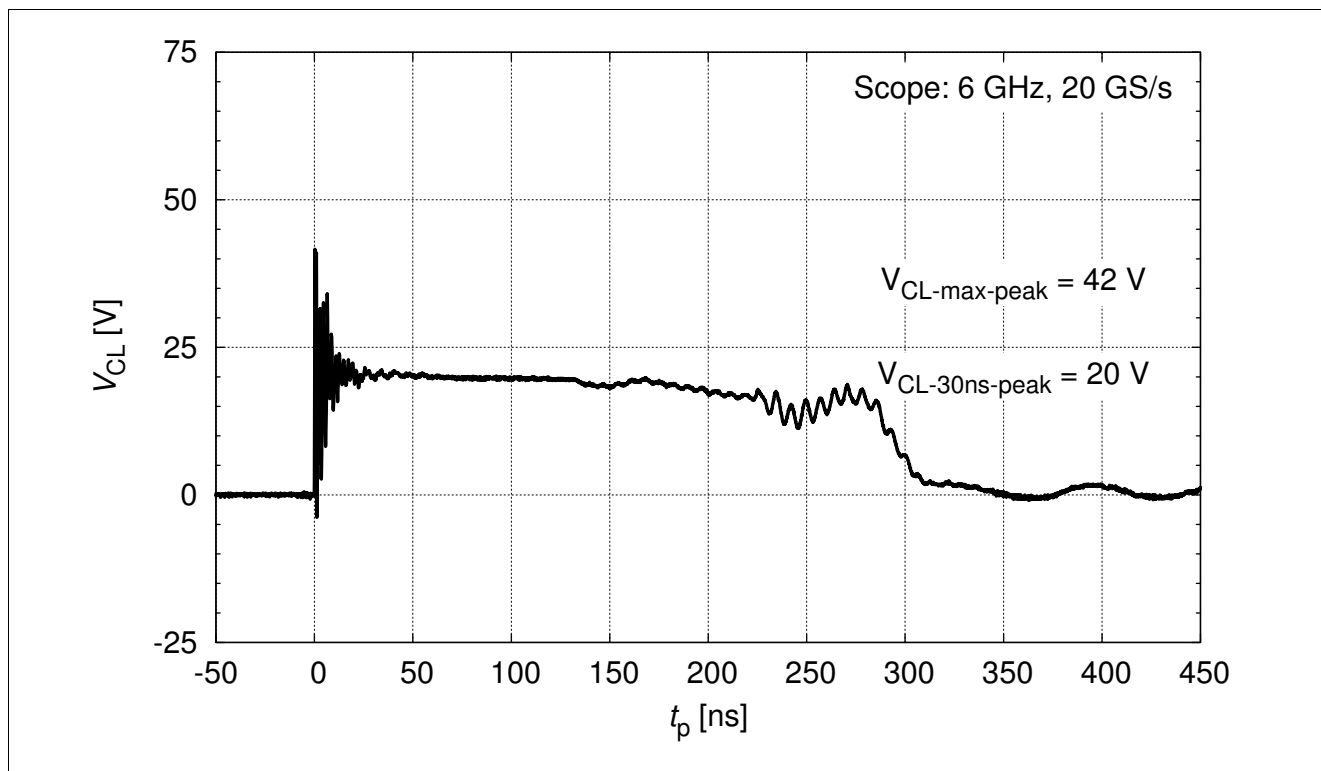


Figure 4-3 Clamping voltage (ESD):  $V_{CL} = f(t)$ , 8 kV positive pulse from pin 1 to pin 2

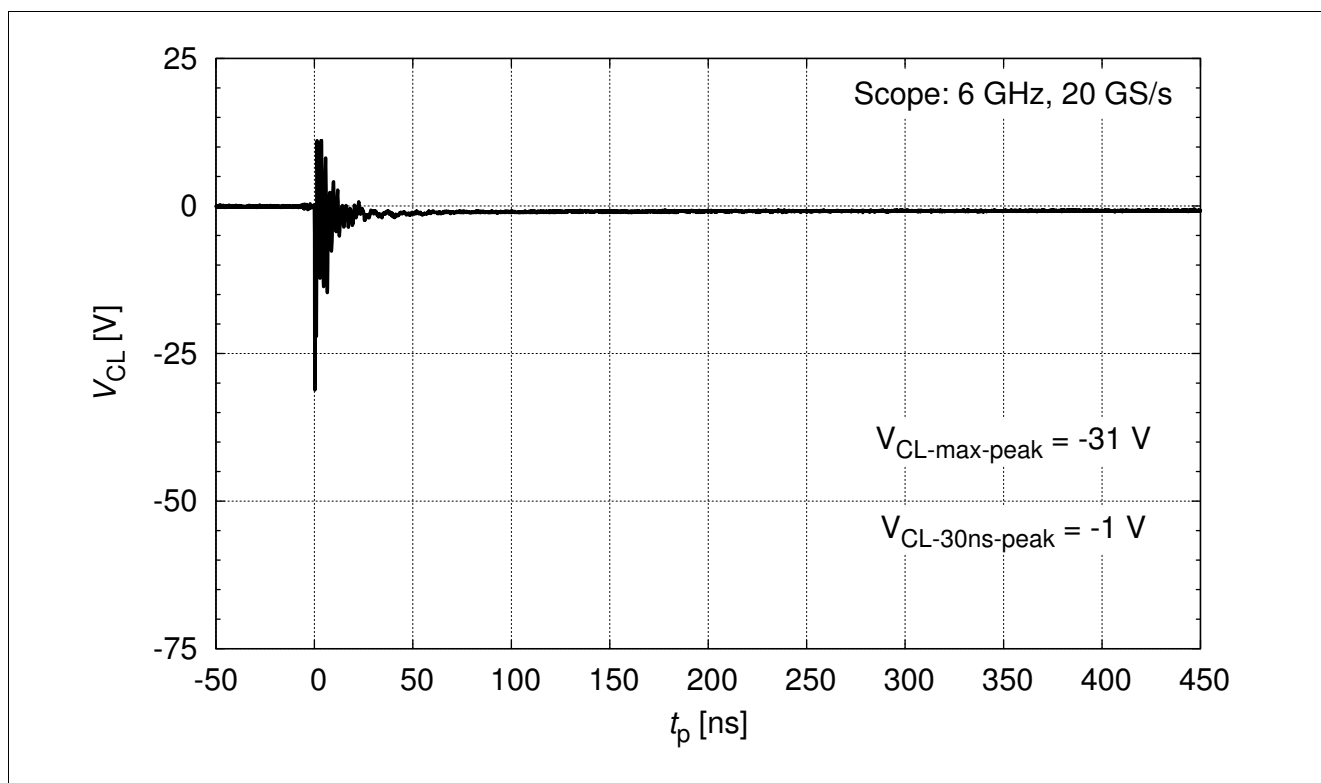


Figure 4-4 Clamping voltage (ESD)  $V_{CL} = f(t)$ , 8 kV negative pulse from pin 1 to pin 2

# Typical Characteristics Diagrams

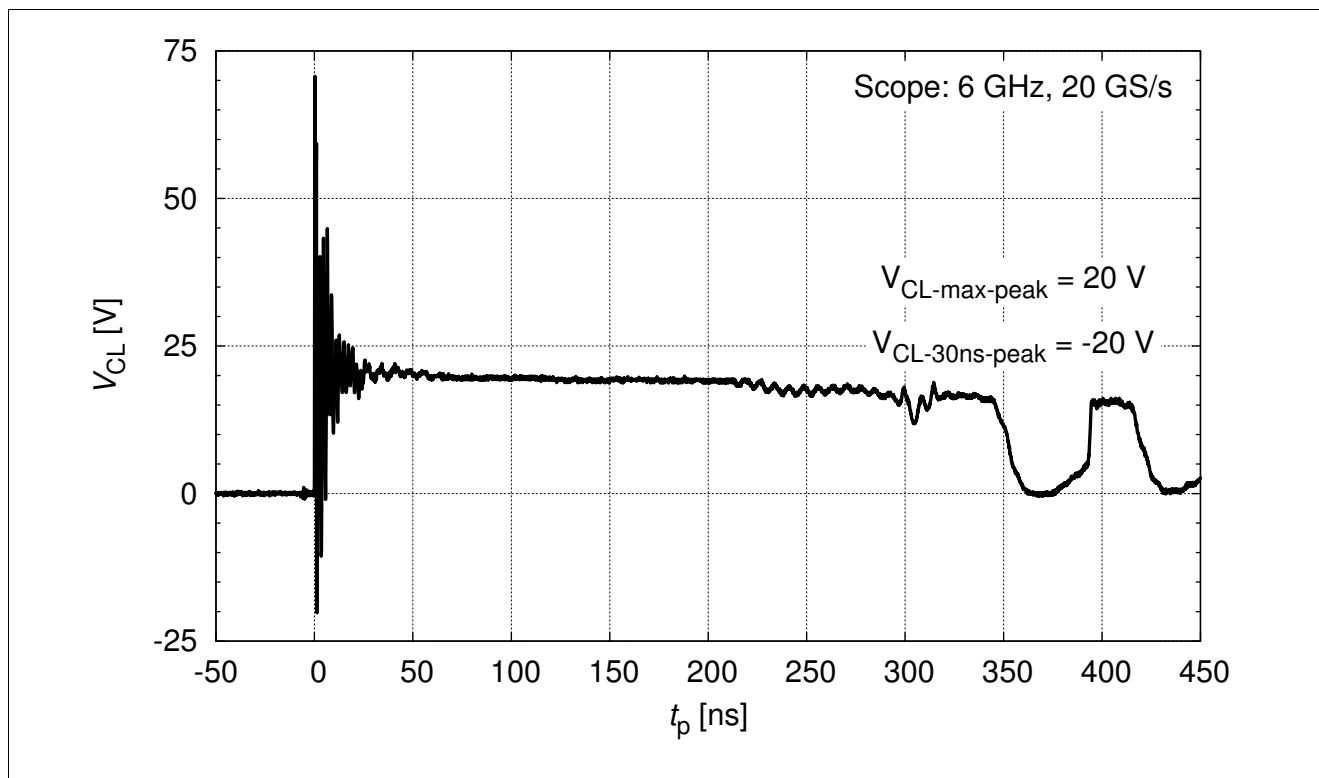


Figure 4-5 Clamping voltage (ESD)  $V_{CL} = f(t)$ , 15 kV positive pulse from pin 1 to pin 2

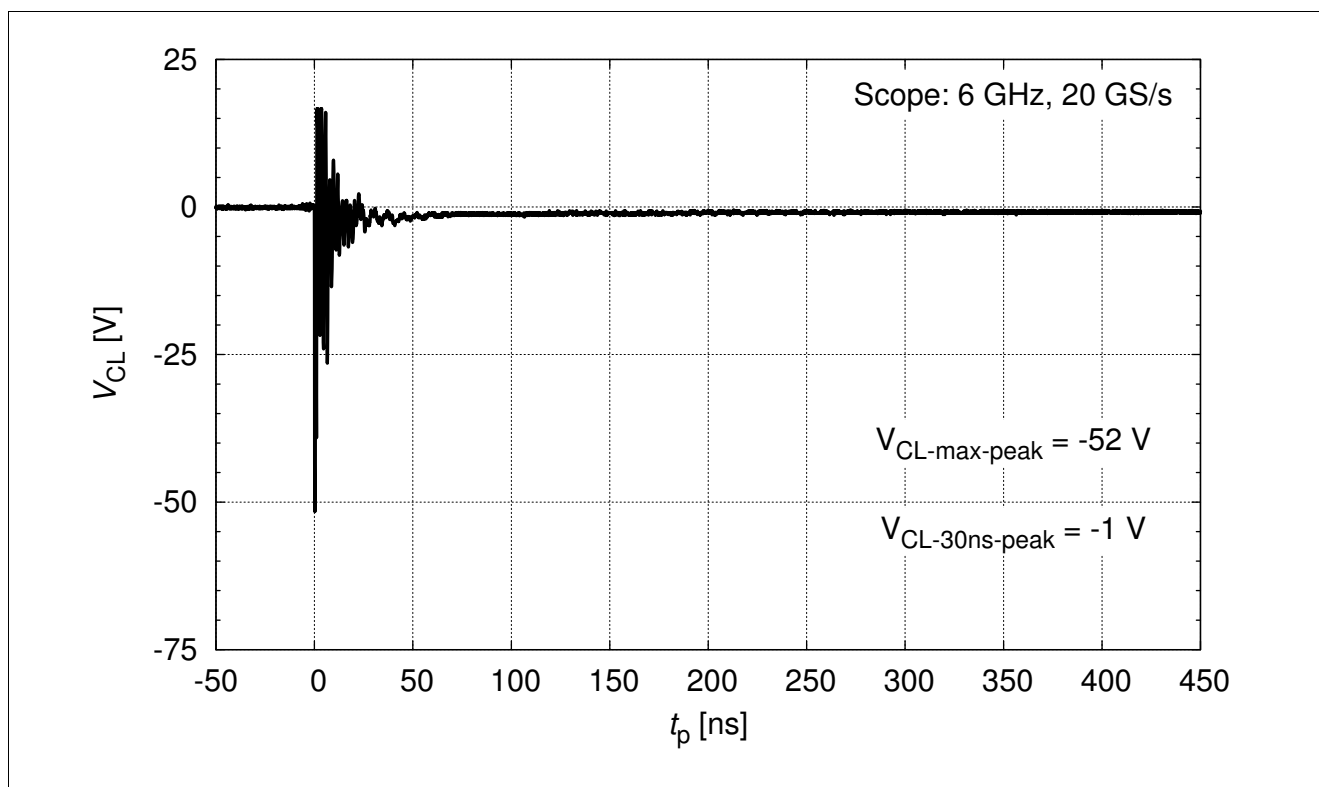


Figure 4-6 Clamping voltage (ESD)  $V_{CL} = f(t)$ , 15 kV negative pulse from pin 1 to pin 2

## Typical Characteristics Diagrams

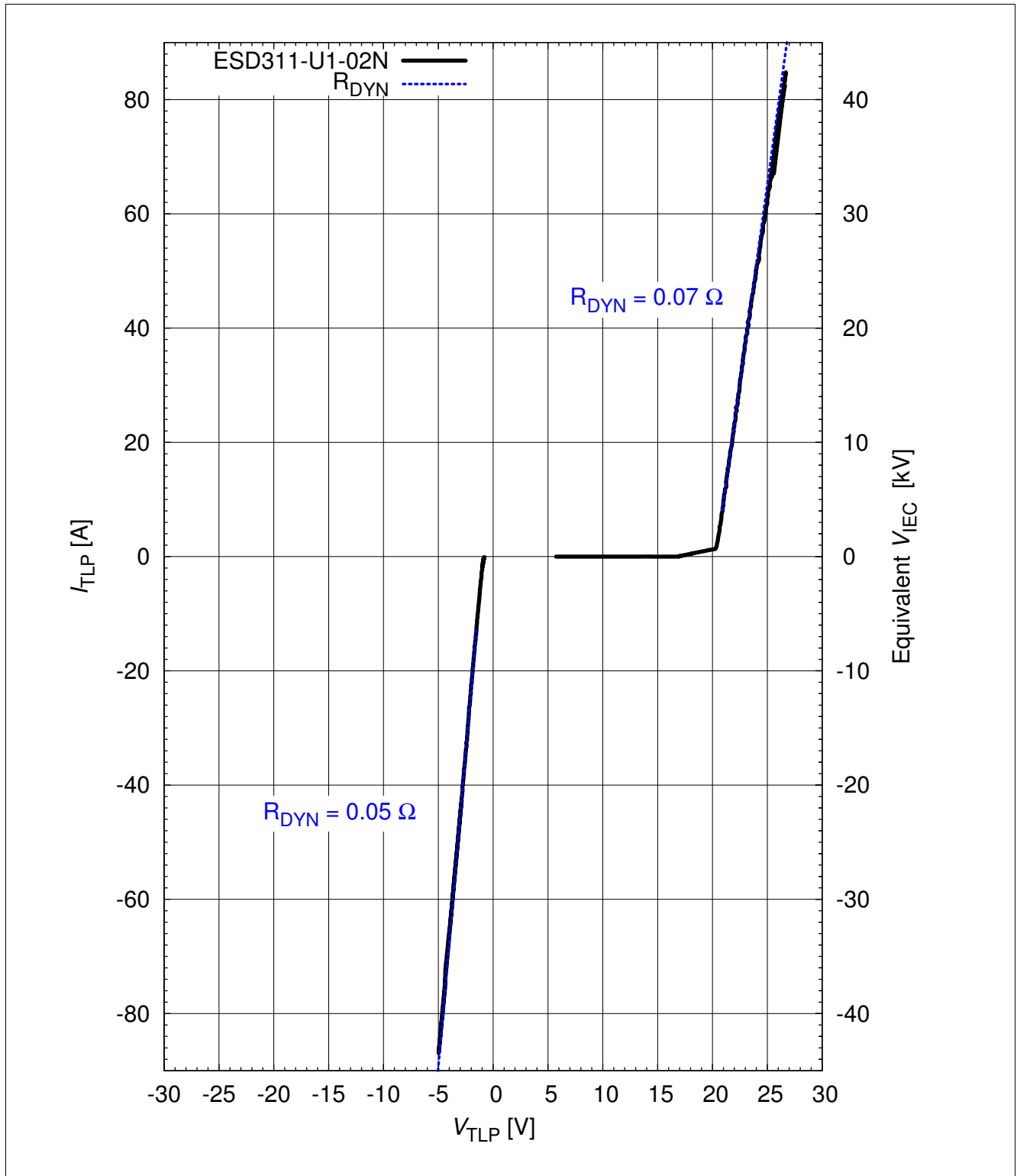


Figure 4-7 Clamping voltage (TLP):  $I_{TLP} = f(V_{TLP})$ [1], pin 1 to pin 2

# Typical Characteristics Diagrams

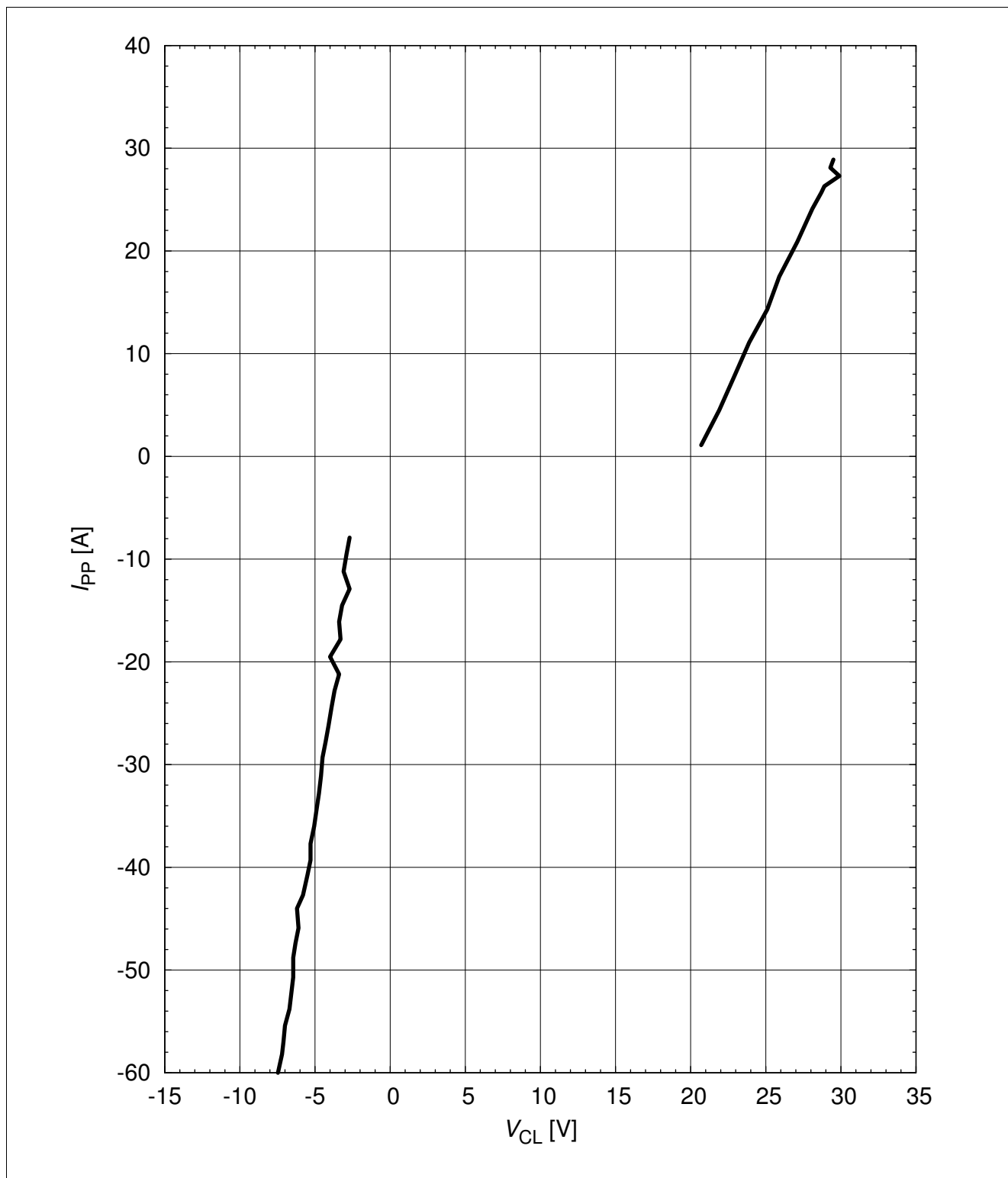


Figure 4-8 Pulse current (Surge):  $I_{PP} = f(V_{CL})$ [1], pin 1 to pin 2

## 5 Package Information

### 5.1 TSNP-2-2

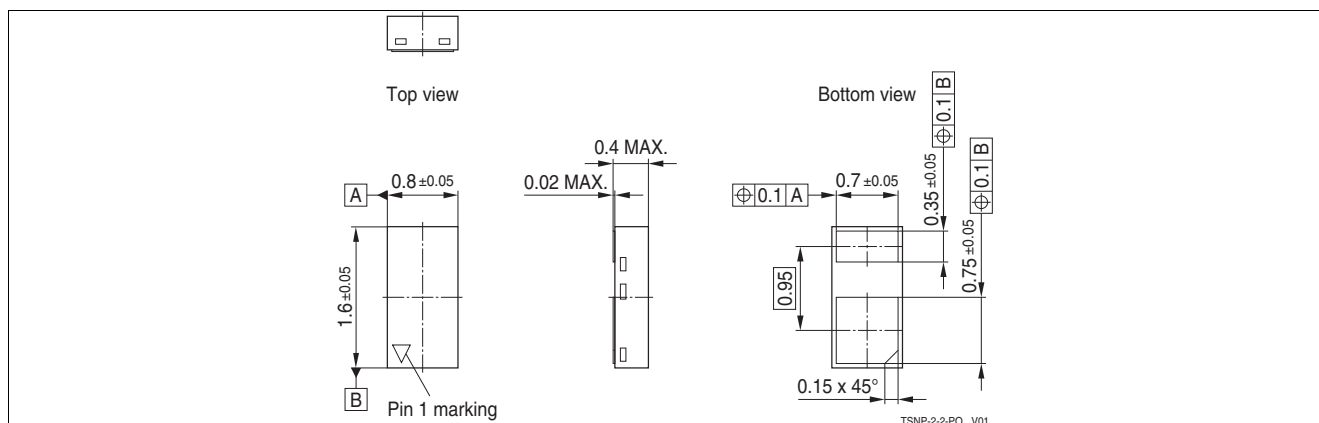


Figure 5-1 TSNP-2-2: Package outline

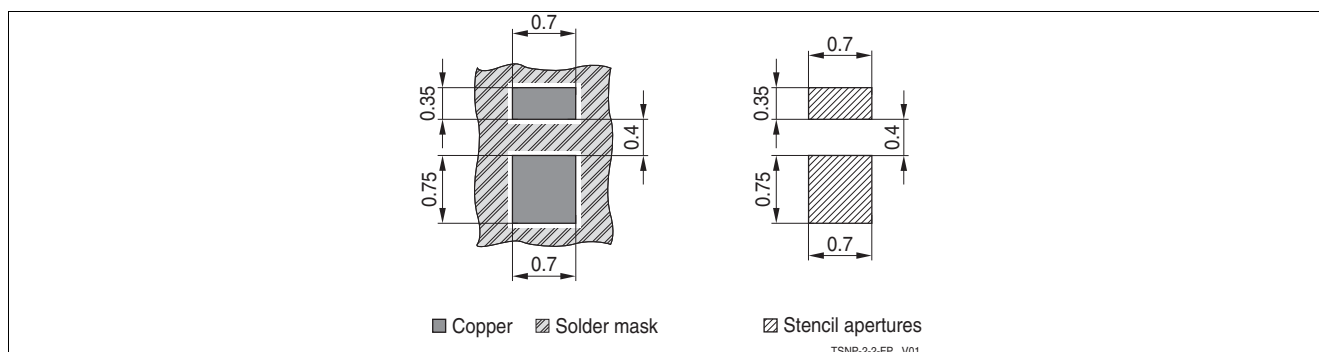


Figure 5-2 TSNP-2-2: Footprint

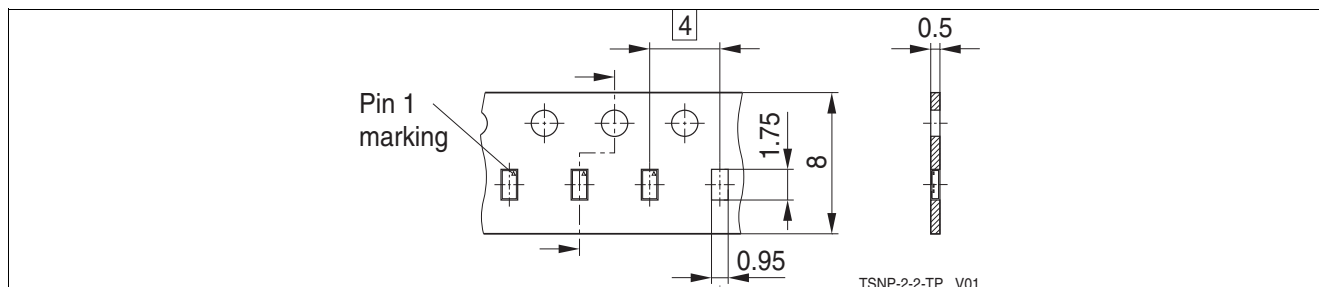


Figure 5-3 TSNP-2-2: Packing

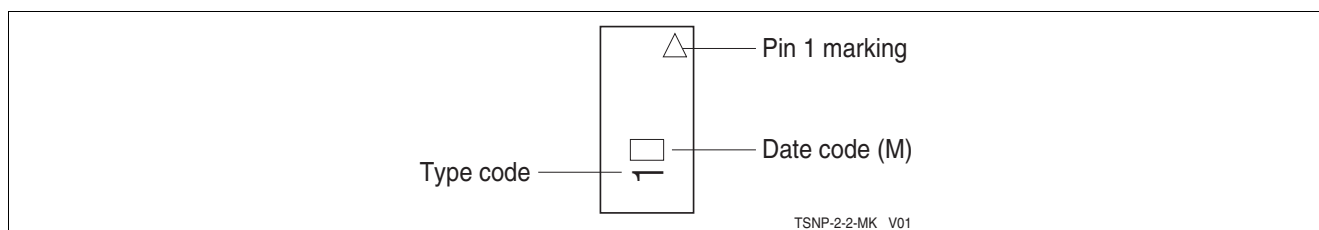


Figure 5-4 TSNP-2-2: Marking example, Type code see: [Table 1-1 "Part Information" on Page 3](#)

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| Page or Item | Subjects (major changes since previous revision) |
|--------------|--------------------------------------------------|
|--------------|--------------------------------------------------|

**Revision 1.0, 2014-05-28**

|     |                        |
|-----|------------------------|
| All | Status change to final |
|     |                        |
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