



# PESD2CANFD24V-QC

ESD protection for In-vehicle networks

30 September 2020

Product data sheet

## 1. General description

ESD protection device in an ultra small DFN1412D-3 (SOT8009) leadless Surface-Mounted Device (SMD) plastic package with side wettable flanks designed to protect two automotive In-vehicle network bus lines from the damage caused by ElectroStatic discharge (ESD) and other transients.

## 2. Features and benefits

- Reverse stand-off voltage:  $V_{RWM} = 24\text{ V}$
- Low clamping voltage:  $V_{CL} = 33\text{ V}$  at  $I_{PP} = 1\text{ A}$
- ESD protection up to 23 kV (IEC 61000-4-2)
- Low capacitance:  $C_d = 6\text{ pF}$
- ESD protection up to 23 kV (ISO 10605;  $C = 150\text{ pF}$ ;  $R = 330\ \Omega$ )
- AEC-Q101 qualified

## 3. Applications

ESD protection for In-vehicle network lines in automotive environments

- CAN-FD
- CAN
- FlexRay
- SENT

## 4. Quick reference data

Table 1. Quick reference data

| Symbol    | Parameter                | Conditions  |         | Min | Typ | Max | Unit |
|-----------|--------------------------|---|---------|-----|-----|-----|------|
| $V_{RWM}$ | reverse standoff voltage | $T_{amb} = 25\text{ }^\circ\text{C}$  |         | -   | -   | 24  | V    |
| $I_{PPM}$ | rated peak pulse current | $t_p = 8/20\ \mu\text{s}$   | [1] [2] | -   | -   | 2.6 | A    |
| $V_{CL}$  | clamping voltage         | $I_{PPM} = 1\text{ A}$ ; $t_p = 8/20\ \mu\text{s}$ ; $T_{amb} = 25\text{ }^\circ\text{C}$ | [3] [2] | -   | 33  | 42  | V    |

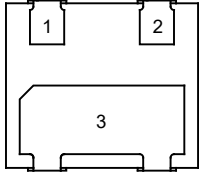
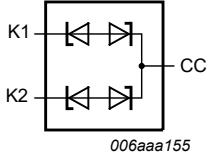
[1] According to IEC 61000-4-5.

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

[3] Device stressed with 8/20  $\mu\text{s}$  exponential decay waveform according to IEC 61000-4-5.

## 5. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description       | Simplified outline  | Graphic symbol   |
|-----|--------|-------------------|---|--|
| 1   | K1     | cathode (diode 1) |  <p>Bottom view<br/>DFN1412D-3 (SOT8009)</p> |  <p>006aaa155</p> |
| 2   | K2     | cathode (diode 2) |   |  |
| 3   | CC     | common cathode    |   |  |

## 6. Ordering information

Table 3. Ordering information

| Type number      | Package    |   |         |
|------------------|------------|---|---------|
|                  | Name       | Description   | Version |
| PESD2CANFD24V-QC | DFN1412D-3 | plastic, leadless extremely thin small outline package with side-wettable flanks (SWF); 3 terminals; 0.8 mm pitch; 1.4 mm x 1.2 mm x 0.48 mm body | SOT8009 |

## 7. Marking

Table 4. Marking codes

| Type number      | Marking code |
|------------------|--------------|
| PESD2CANFD24V-QC | 6D           |

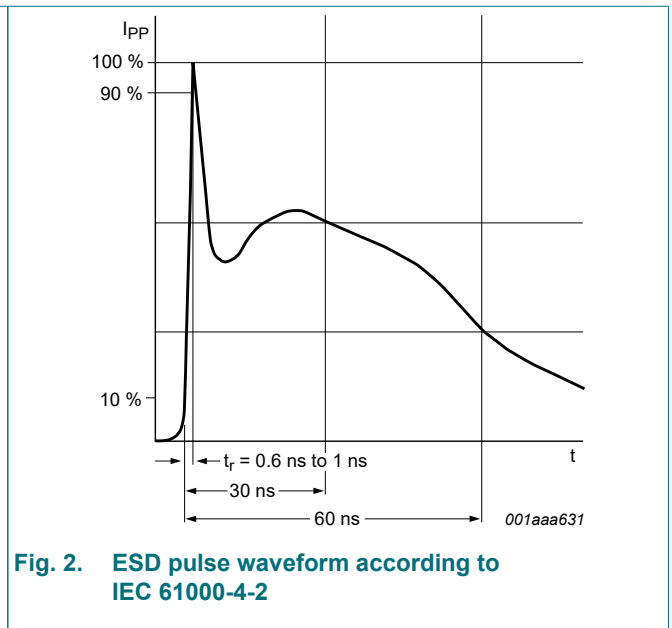
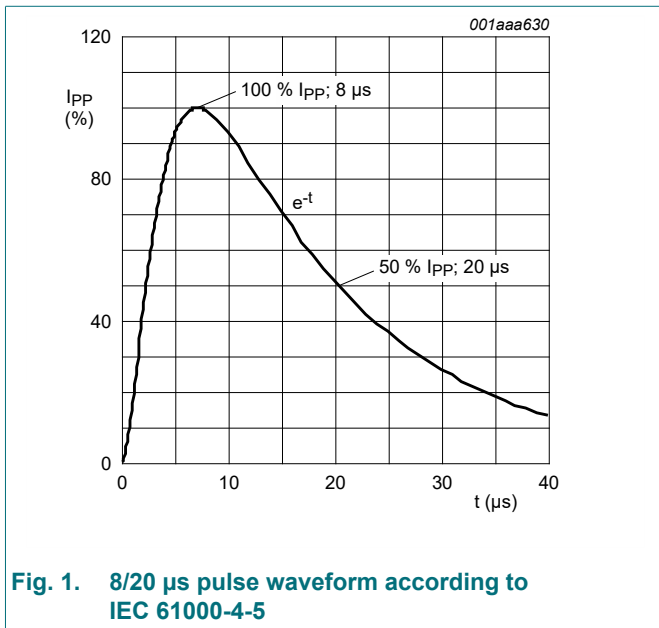
## 8. Limiting values

**Table 5. Limiting values**

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

| Symbol                     | Parameter                       | Conditions   |         | Min | Max | Unit |
|----------------------------|---------------------------------|--|---------|-----|-----|------|
| $I_{PPM}$                  | rated peak pulse current        | $t_p = 8/20 \mu s$   | [1] [2] | -   | 2.6 | A    |
| $T_j$                      | junction temperature            |  |         | -   | 150 | °C   |
| $T_{amb}$                  | ambient temperature             |  |         | -55 | 150 | °C   |
| $T_{stg}$                  | storage temperature             |  |         | -65 | 150 | °C   |
| <b>ESD maximum ratings</b> |                                 |  |         |     |     |      |
| $V_{ESD}$                  | electrostatic discharge voltage | IEC 61000-4-2; contact discharge                           | [2] [3] | -   | 23  | kV   |
|                            |                                 | ISO 10605; contact discharge; C = 330 pF, R = 330 $\Omega$ | [2] [3] | -   | 20  | kV   |
|                            |                                 | ISO 10605; contact discharge; C = 150 pF, R = 330 $\Omega$ | [2] [3] | -   | 23  | kV   |

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



### 9. Characteristics

Table 6. Characteristics

| Symbol           | Parameter                  | Conditions  |         | Min  | Typ | Max  | Unit     |
|------------------|----------------------------|---|---------|------|-----|------|----------|
| $V_{RWM}$        | reverse standoff voltage   | $T_{amb} = 25\text{ }^{\circ}\text{C}$  |         | -    | -   | 24   | V        |
| $V_{BR}$         | breakdown voltage          | $I_R = 10\text{ mA}; T_{amb} = 25\text{ }^{\circ}\text{C}$                                  | [1]     | 25.5 | -   | 35.5 | V        |
| $I_{RM}$         | reverse leakage current    | $V_{RWM} = 24\text{ V}; T_{amb} = 25\text{ }^{\circ}\text{C}$                               | [1]     | -    | 1   | 50   | nA       |
| $C_d$            | diode capacitance          | $f = 1\text{ MHz}; V_R = 2.5\text{ V}; T_{amb} = 25\text{ }^{\circ}\text{C}$                | [1]     | -    | 5.2 | 6    | pF       |
|                  |                            | $f = 1\text{ MHz}; V_R = -2.5\text{ V}; T_{amb} = 25\text{ }^{\circ}\text{C}$               | [1]     | -    | 5.2 | 6    | pF       |
| $\Delta C_d/C_d$ | diode capacitance matching | $f = 1\text{ MHz}; V_R = 2.5\text{ V}; T_{amb} = 25\text{ }^{\circ}\text{C}$                | [2]     | -    | 0.5 | -    | %        |
|                  |                            | $f = 1\text{ MHz}; V_R = -2.5\text{ V}; T_{amb} = 25\text{ }^{\circ}\text{C}$               | [2]     | -    | 0.5 | -    | %        |
| $V_{CL}$         | clamping voltage           | $I_{PPM} = 1\text{ A}; t_p = 8/20\text{ }\mu\text{s}; T_{amb} = 25\text{ }^{\circ}\text{C}$ | [3] [1] | -    | 33  | 42   | V        |
| $R_{dyn}$        | dynamic resistance         | $I_R = 10\text{ A}; T_{amb} = 25\text{ }^{\circ}\text{C}$                                   | [4] [1] | -    | 0.7 | -    | $\Omega$ |

- [1] Measured from pin 1 or 2 to pin 3.
- [2]  $\Delta C_d$  is the difference of the capacitance measured between pin 1 and pin 3 and the capacitance measured between pin 2 and pin 3.
- [3] Device stressed with 8/20  $\mu\text{s}$  exponential decay waveform according to IEC 61000-4-5.
- [4] Non-repetitive current pulse, Transmission Line Pulse (TLP); square pulse; ANSI / ESD STM5.5.1-2008

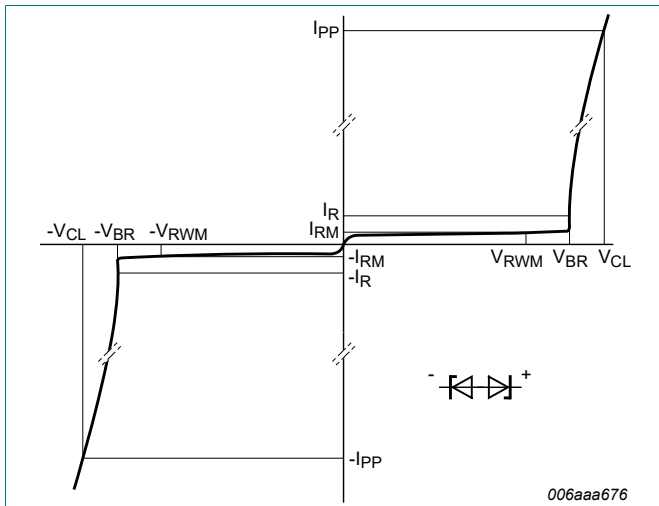


Fig. 3. V-I characteristics for a bidirectional ESD protection diode

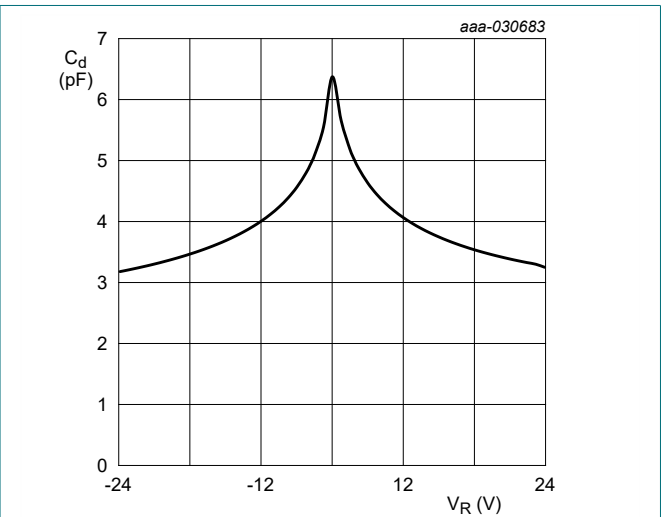
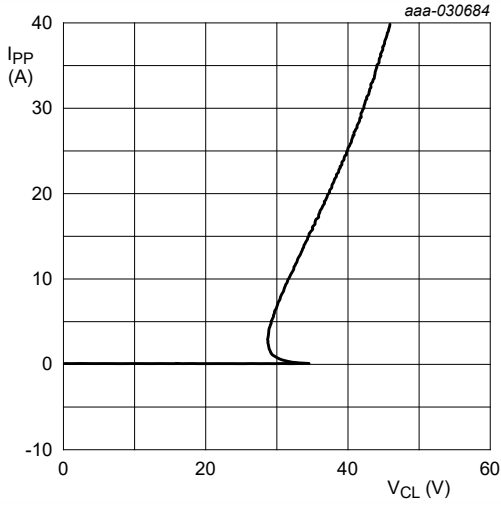
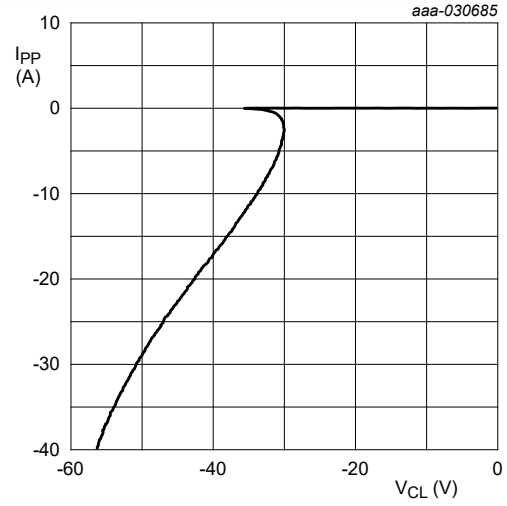


Fig. 4. Diode capacitance as a function of reverse voltage; typical values



$t_p = 100 \text{ ns}$ ; Transmission Line Pulse (TLP)

Fig. 5. Positive clamping voltage (TLP); typical values



$t_p = 100 \text{ ns}$ ; Transmission Line Pulse (TLP)

Fig. 6. Negative clamping voltage (TLP); typical values

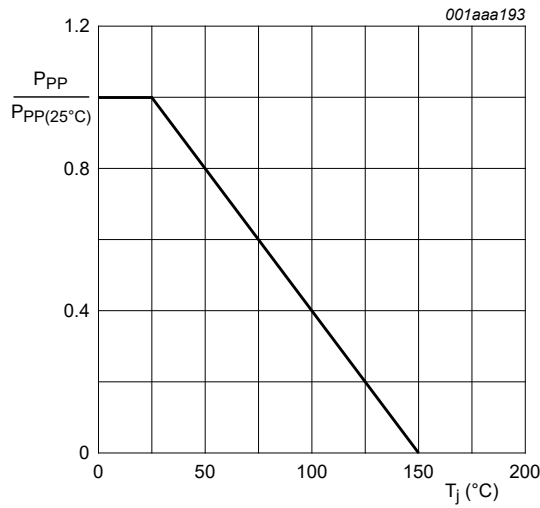


Fig. 7. Relative variation of peak pulse power as a function of junction temperature; typical values

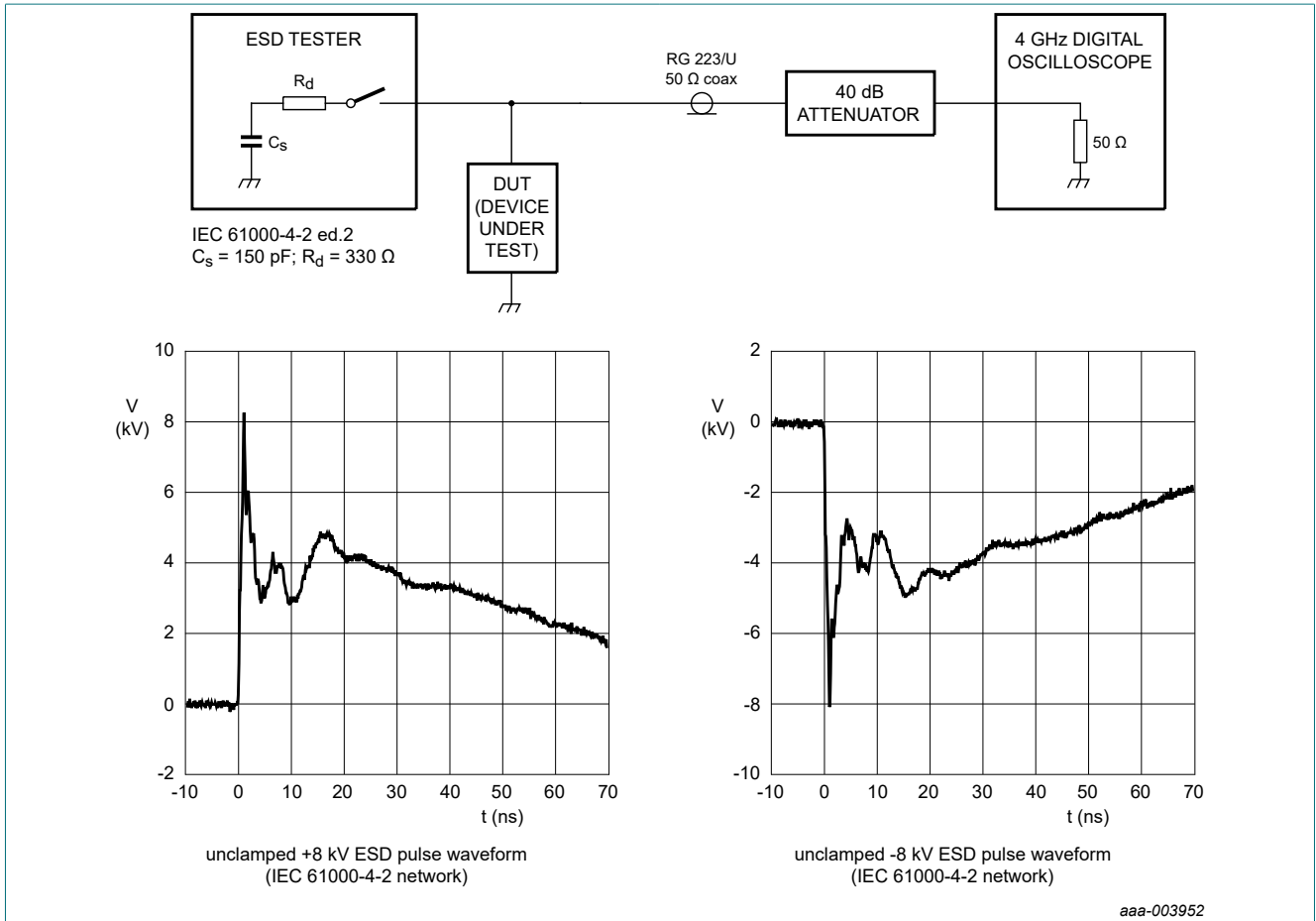
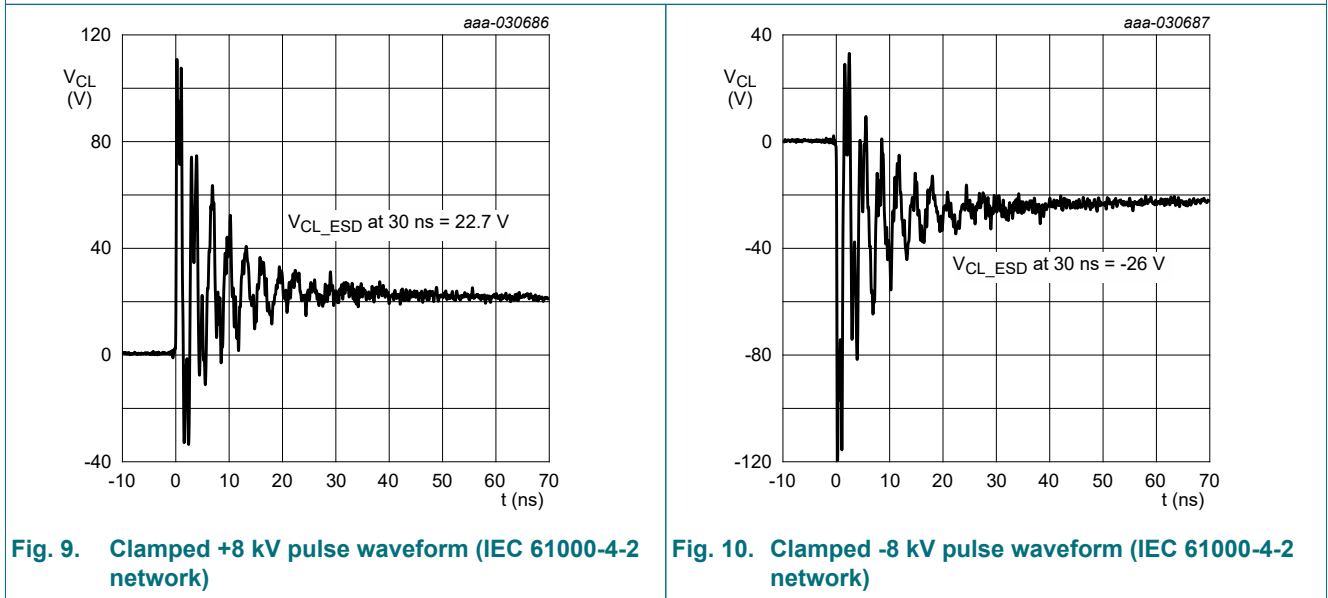


Fig. 8. ESD clamping test setup and waveforms



## 10. Application information

The device is designed for the protection of two automotive in-vehicle bus lines, e.g. CAN (FD), from the damage caused by ESD and surge pulses.

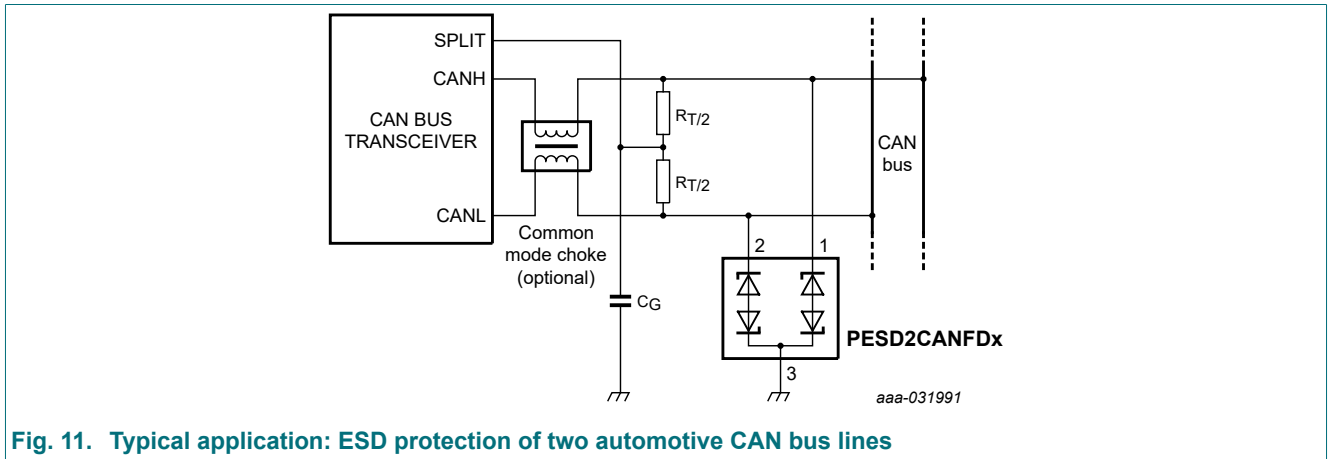


Fig. 11. Typical application: ESD protection of two automotive CAN bus lines

### 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

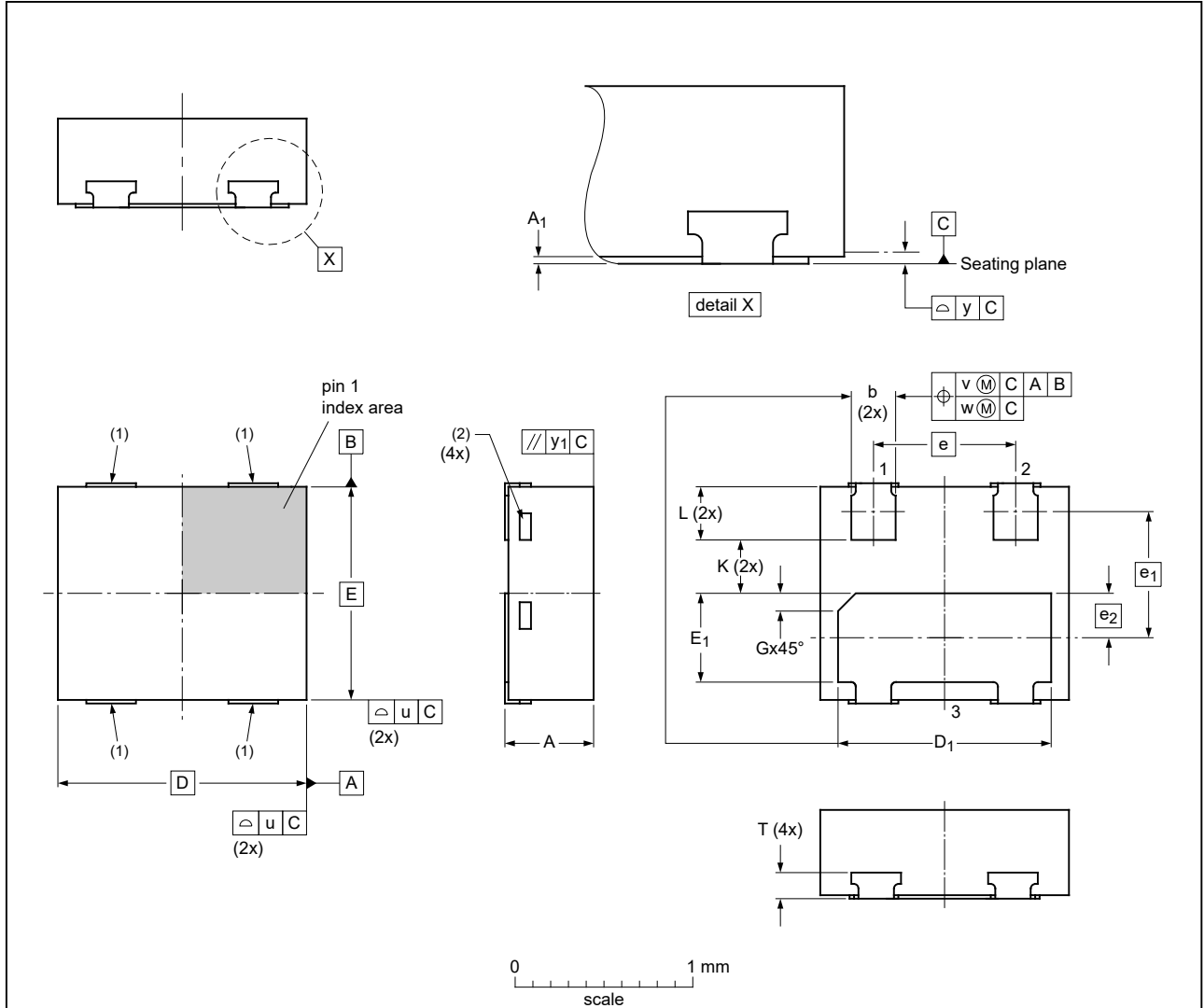
### Quality information

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

DFN1412D-3: plastic, leadless extremely thin small outline package with side-wettable flanks (SWF); 3 terminals; 0.8 mm pitch; 1.4 mm x 1.2 mm x 0.48 mm body

SOT8009



Dimensions (mm are the original dimensions)

| Unit | A    | A <sub>1</sub> | b    | D    | D <sub>1</sub> | E   | E <sub>1</sub> | e   | e <sub>1</sub> | e <sub>2</sub> | G     | K    | L    | T    | u    | v   | w    | y    | y <sub>1</sub> |
|------|------|----------------|------|------|----------------|-----|----------------|-----|----------------|----------------|-------|------|------|------|------|-----|------|------|----------------|
| max  | 0.50 | 0.04           | 0.30 | 1.25 | 0.55           |     |                |     |                |                |       |      | 0.35 | 0.22 |      |     |      |      |                |
| nom  | 0.47 |                | 0.25 | 1.4  | 1.20           | 1.2 | 0.50           | 0.8 | 0.71           | 0.26           | 0.09  |      | 0.30 | 0.16 | 0.05 | 0.1 | 0.05 | 0.05 | 0.05           |
| min  | 0.44 |                | 0.22 | 1.17 | 0.47           |     |                |     |                |                | (ref) | 0.25 | 0.27 | 0.10 |      |     |      |      |                |

Note

- Side Wettable Flank, protrusion max. 0.02 mm.
  - Visible depend upon used manufacturing technology.
- Dimension A and T are including plating thickness.

sot8009\_po

| Outline version | References |          |       |  | European projection | Issue date           |
|-----------------|------------|----------|-------|--|---------------------|----------------------|
|                 | IEC        | JEDEC    | JEITA |  |                     |                      |
| SOT8009         |            | MO-340CA |       |  |                     | 19-12-04<br>19-12-06 |

Fig. 12. Package outline DFN1412D-3 (SOT8009)



### 13. Soldering

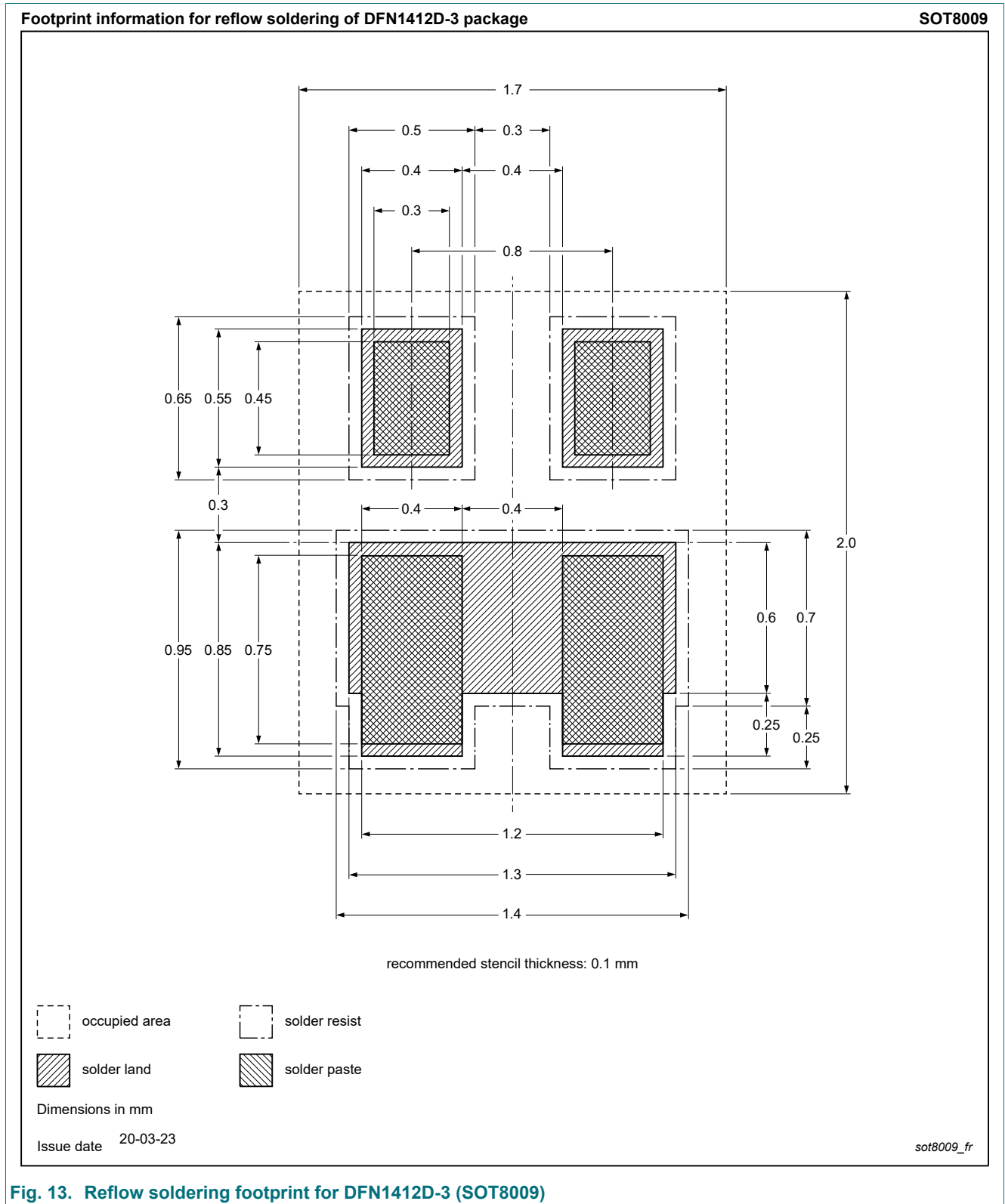


Fig. 13. Reflow soldering footprint for DFN1412D-3 (SOT8009)

### 14. Revision history

Table 7. Revision history

| Data sheet ID        | Release date | Data sheet status  | Change notice | Supersedes |
|----------------------|--------------|--------------------|---------------|------------|
| PESD2CANFD24V-QC v.1 | 20200930     | 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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