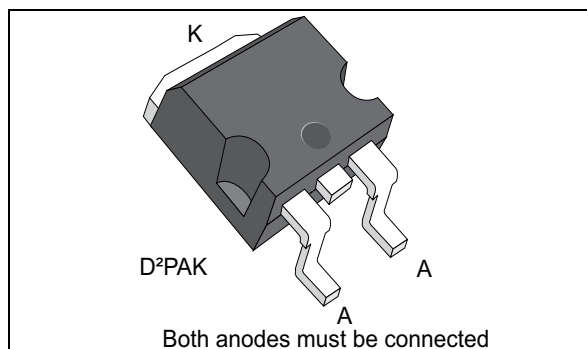


## Automotive TVS for load dump protection

Datasheet - production data



### Description

The LDP01-xxAY Transil™ series have been designed to protect automotive sensitive circuits against surges defined in ISO 7637-2 and ISO 16750 tests A and B also called load-dump.

The planar technology makes it compatible with high-end circuits where low leakage current and high junction temperature are required to provide reliability and stability over time.

LDP01-xxAY is packaged in D²PAK.

### Features

- Stand-off voltage range: from 22 to 70 V
- Low leakage current: 1  $\mu$ A at 25 °C
- Operating  $T_j$  max: 175 °C
- High power capability at  $T_j$  max
- JEDEC registered package outline
- ROHS and Halogen free
- Resin meets UL 94, V0
- AEC-Q101 compliant

### Complies with the following standards:

- IEC 61000-4-2 exceeds level 4
  - 30 kV (air discharge)
  - 30 kV (contact discharge)
- ISO10605 – C = 330 pF, R = 330  $\Omega$ 
  - 30 kV (air discharge)
  - 30 kV (contact discharge)
- ISO 7637-2
  - Pulse 1:  $V_S = -150$  V
  - Pulse 2a:  $V_S = +112$  V
  - Pulse 3a:  $V_S = -220$  V
  - Pulse 3b:  $V_S = +150$  V
  - Formerly pulses 5a and 5b
- ISO 16750-2
  - Tests A and B

Table 1. Device summary

| Part number | Breakdown voltage<br>( $V_{BR}$ at $I_R = 1$ mA) |      |      |
|-------------|--------------------------------------------------|------|------|
|             | min.                                             | typ. | max. |
|             | V                                                |      |      |
| LDP01-26AY  | 24.4                                             | 26   | 27.0 |
| LDP01-28AY  | 26.7                                             | 28   | 29.5 |
| LDP01-30AY  | 28.9                                             | 30   | 31.9 |
| LDP01-33AY  | 31.1                                             | 33   | 34.3 |
| LDP01-35AY  | 33.3                                             | 35   | 36.9 |
| LDP01-39AY  | 36.7                                             | 39   | 40.5 |
| LDP01-42AY  | 40                                               | 42   | 44.2 |
| LDP01-47AY  | 44.4                                             | 47   | 49   |
| LDP01-50AY  | 47.8                                             | 50   | 52.8 |
| LDP01-56AY  | 53.3                                             | 56   | 58.9 |
| LDP01-68AY  | 64.4                                             | 68   | 71.2 |
| LDP01-82AY  | 77.8                                             | 82   | 86   |

# 1 Characteristics

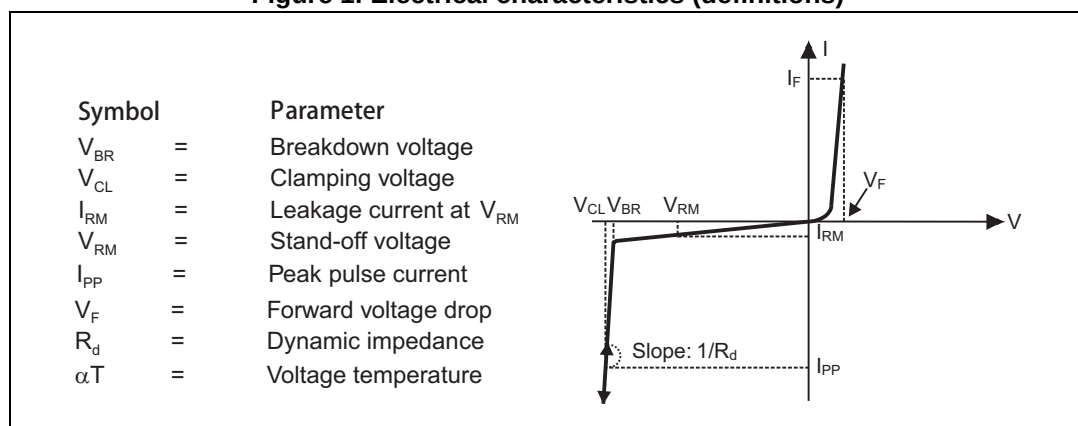
**Table 2. Absolute maximum ratings ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ )**

| Symbol    | Parameter                                          |                                           | Value        | Unit               |
|-----------|----------------------------------------------------|-------------------------------------------|--------------|--------------------|
| $V_{PP}$  | Peak pulse voltage                                 | ISO 10605 (C = 330 pF, R = 330 $\Omega$ ) |              | kV                 |
|           |                                                    | – contact discharge                       | 30           |                    |
|           |                                                    | – air discharge                           | 30           |                    |
|           |                                                    | IEC 61000-4-2                             |              |                    |
|           |                                                    | – contact discharge                       | 30           |                    |
|           |                                                    | – air discharge                           | 30           |                    |
| $T_{stg}$ | Storage temperature range                          |                                           | -65 to + 175 | $^{\circ}\text{C}$ |
| $T_j$     | Operating junction temperature range               |                                           | -55 to + 175 | $^{\circ}\text{C}$ |
| $T_L$     | Maximum lead temperature for soldering during 10 s |                                           | 260          | $^{\circ}\text{C}$ |

**Table 3. Thermal parameter**

| Symbol        | Parameter        |                    | Maximum | Unit                 |
|---------------|------------------|--------------------|---------|----------------------|
| $R_{th(j-c)}$ | Junction to case | D <sup>2</sup> PAK | 0.24    | $^{\circ}\text{C/W}$ |

**Figure 1. Electrical characteristics (definitions)**



**Figure 2. Pulse definition for electrical characteristics**

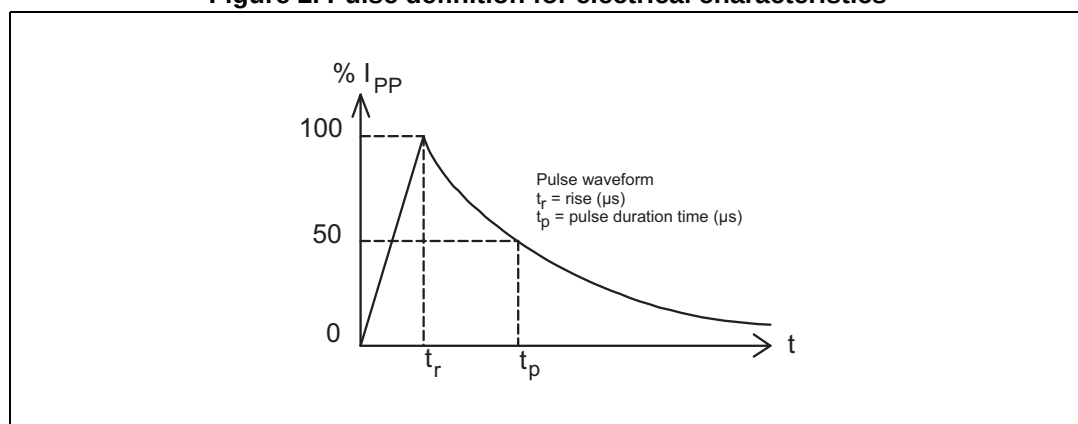


Table 4. Electrical characteristics (parameter)

| Order code | $I_{RM}$ max. at $V_{RM}$ |        |    | $V_{BR}$ at $I_R^{(1)}$ |      |      |    | $V_{CL}$ at $I_{PP}$<br>10/1000 $\mu s$ |     | $R_D^{(2)}$<br>10/1000<br>$\mu s$ | $V_{CL}$ at $I_{PP}$<br>8/20 $\mu s$ |      | $R_D^{(2)}$<br>8/20 $\mu s$ | $\alpha T^{(3)}$<br>max. |
|------------|---------------------------|--------|----|-------------------------|------|------|----|-----------------------------------------|-----|-----------------------------------|--------------------------------------|------|-----------------------------|--------------------------|
|            | 25 °C                     | 175 °C |    | min.                    | typ. | max. |    | max.                                    |     |                                   | max.                                 |      |                             |                          |
|            | $\mu A$                   |        | V  | V                       |      |      | mA | V                                       | A   | m $\Omega$                        | V                                    | A    | m $\Omega$                  | $10^{-4}/^{\circ}C$      |
| LDP01-26AY | 1                         | 100    | 22 | 24.4                    | 26   | 27.0 | 1  | 36                                      | 140 | 64                                | 42                                   | 1400 | 11                          | 9.6                      |
| LDP01-28AY | 1                         | 100    | 24 | 26.7                    | 28   | 29.5 | 1  | 40                                      | 120 | 88                                | 45                                   | 1250 | 12                          | 9.7                      |
| LDP01-30AY | 1                         | 100    | 27 | 28.9                    | 30   | 31.9 | 1  | 40                                      | 125 | 65                                | 49                                   | 1400 | 12                          | 9.7                      |
| LDP01-33AY | 1                         | 100    | 28 | 31.1                    | 33   | 34.3 | 1  | 43.5                                    | 110 | 75                                | 56                                   | 1250 | 17                          | 9.8                      |
| LDP01-35AY | 1                         | 100    | 30 | 33.3                    | 35   | 36.9 | 1  | 45.5                                    | 95  | 91                                | 60                                   | 1150 | 20                          | 9.9                      |
| LDP01-39AY | 1                         | 100    | 33 | 36.7                    | 39   | 40.5 | 1  | 51.5                                    | 85  | 129                               | 66                                   | 1050 | 24                          | 10                       |
| LDP01-42AY | 1                         | 100    | 36 | 40                      | 42   | 44.2 | 1  | 57                                      | 77  | 166                               | 71                                   | 1000 | 27                          | 10                       |
| LDP01-47AY | 1                         | 100    | 40 | 44.4                    | 47   | 49   | 1  | 63                                      | 65  | 215                               | 76.5                                 | 950  | 29                          | 10.1                     |
| LDP01-50AY | 1                         | 100    | 43 | 47.8                    | 50   | 52.8 | 1  | 68                                      | 55  | 276                               | 81                                   | 900  | 31                          | 10.2                     |
| LDP01-56AY | 1                         | 100    | 48 | 53.3                    | 56   | 58.9 | 1  | 76                                      | 48  | 356                               | 90                                   | 770  | 40                          | 10.3                     |
| LDP01-68AY | 1                         | 100    | 58 | 64.4                    | 68   | 71.2 | 1  | 92                                      | 42  | 495                               | 110                                  | 620  | 63                          | 10.4                     |
| LDP01-82AY | 1                         | 100    | 70 | 77.8                    | 82   | 86   | 1  | 113                                     | 35  | 771                               | 135                                  | 550  | 89                          | 10.5                     |

1. Pulse test:  $t_p < 50$  ms2. To calculate maximum clamping voltage at other surge level, use the following formula:  $V_{CL\max} = R_D \times I_{PP} + V_{BR\max}$ 3. To calculate  $V_{BR}$  or  $V_{CL}$  versus junction temperature, use the following formulas:

$$V_{BR} \text{ at } T_j = V_{BR} \text{ at } 25^{\circ}C \times (1 + \alpha T \times (T_j - 25))$$

$$V_{CL} \text{ at } T_j = V_{CL} \text{ at } 25^{\circ}C \times (1 + \alpha T \times (T_j - 25))$$

Figure 3. Peak pulse power dissipation versus initial junction temperature (LDP01-30AY)

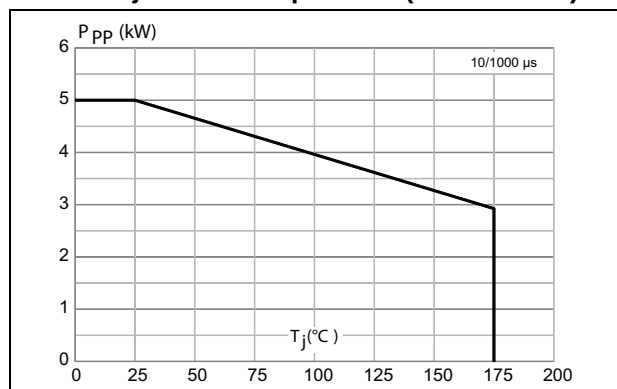


Figure 4. Peak pulse power versus exponential pulse duration (LDP01-30AY)

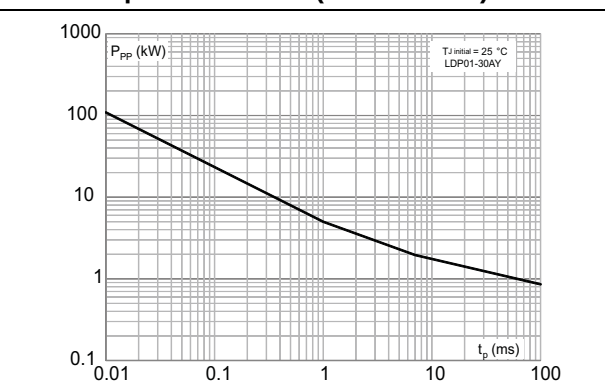


Figure 5. ISO7637-2, pulse 5a definition

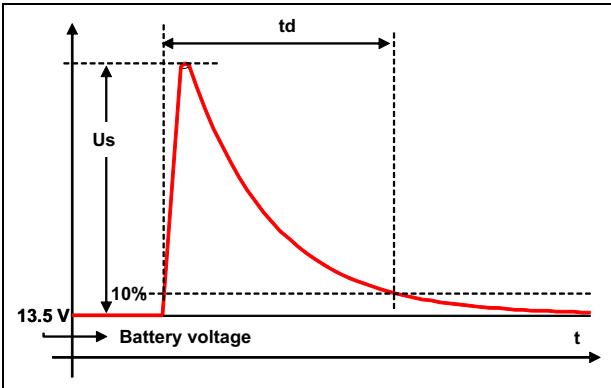


Figure 6. Load dump capability (LDP01-30AY)  
 $U_s = f(R_i)$  pulse 5a)

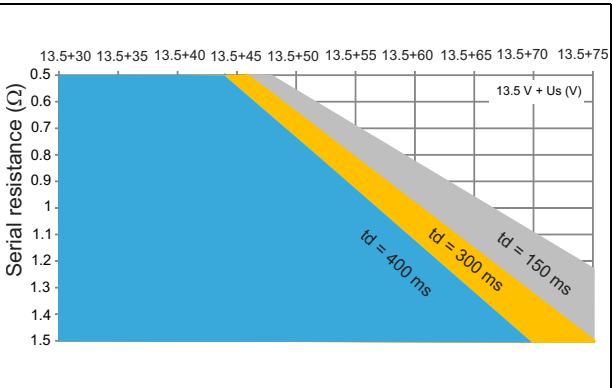


Figure 7. ISO7637-2, pulse 5b definition

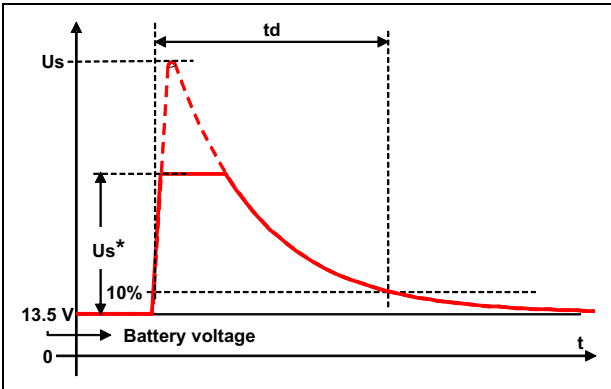


Figure 8. Load dump capability (LDP01-30AY)  
 $U_{s^*} = f(R_i)$  pulse 5b,  $U_s = 87$  V)

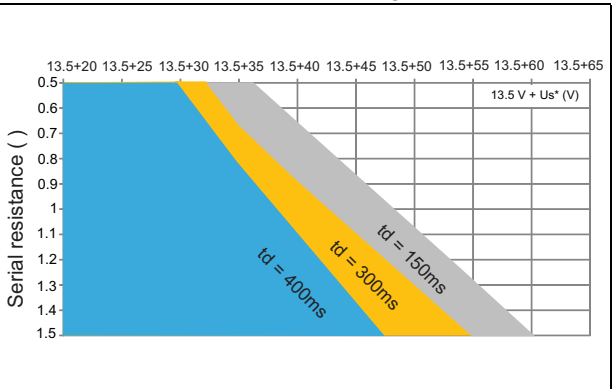


Figure 9. ISO 16750-2, test A definition

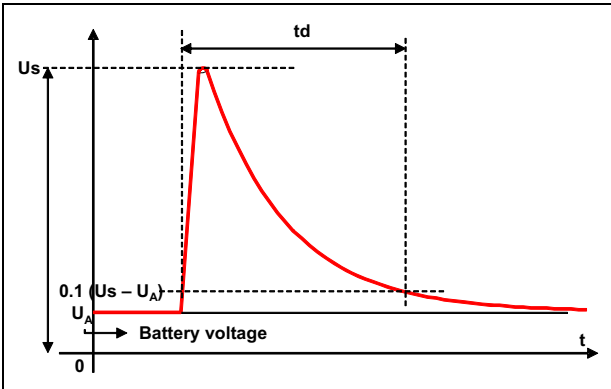


Figure 10. Load dump capability (LDP01-30AY)  
 $U_s = f(R_i)$ , Test A)

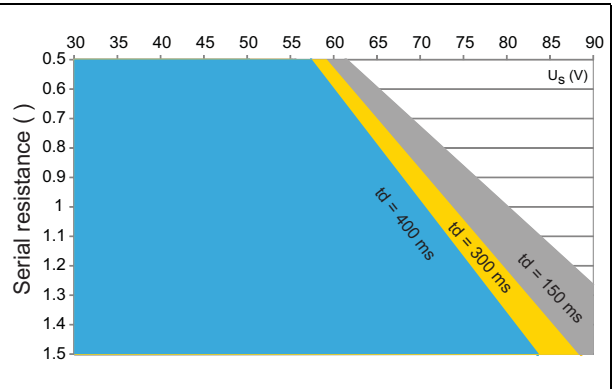


Figure 11. ISO 16750-2, test B definition

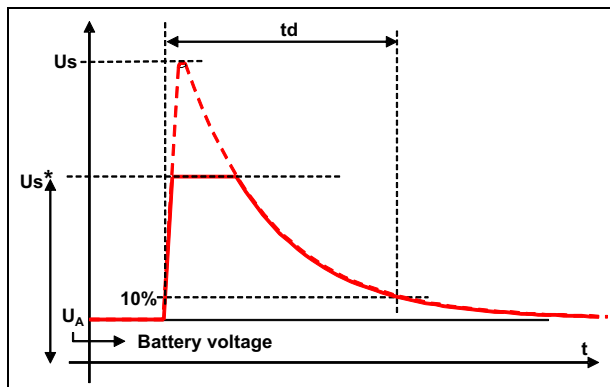
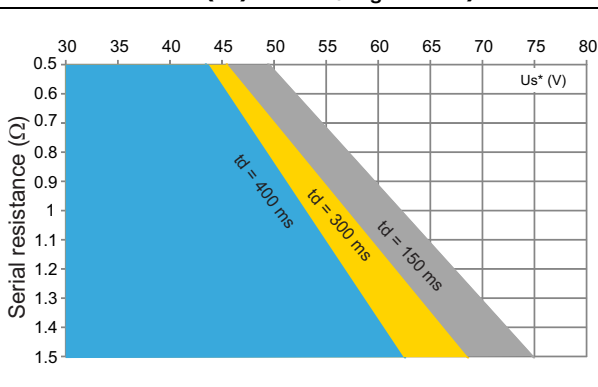
Figure 12. Load dump capability (LDP01-30AY)  
 $U_s^* = f(R_i)$  Test B,  $U_s = 87 \text{ V}$ 

Figure 13. Clamping voltage versus peak pulse current (maximum values)

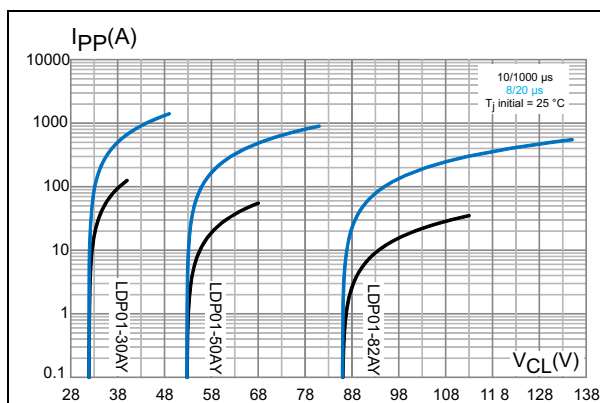
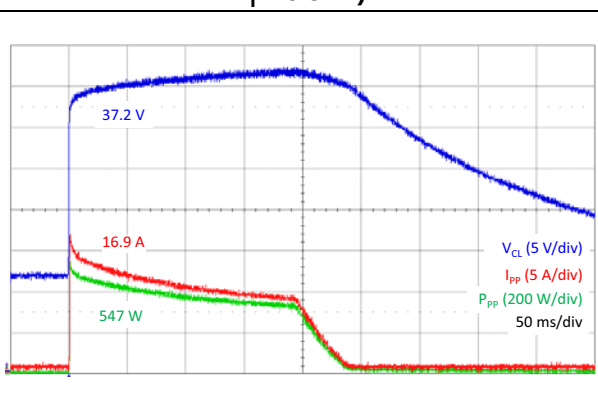
Figure 14. ISO 16750-2 test B response  
 $(U_A + U_s^* = 13.5 + 30 \text{ V}, U_s = 87 \text{ V}, t_d = 400 \text{ ms}, R_i = 0.5 \Omega)$ 

Figure 15. Peak forward voltage versus peak forward current (typical values)

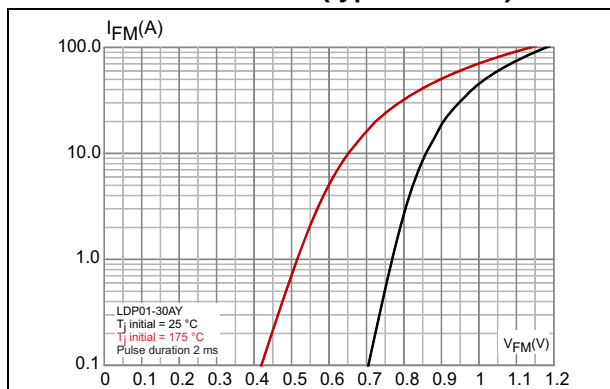
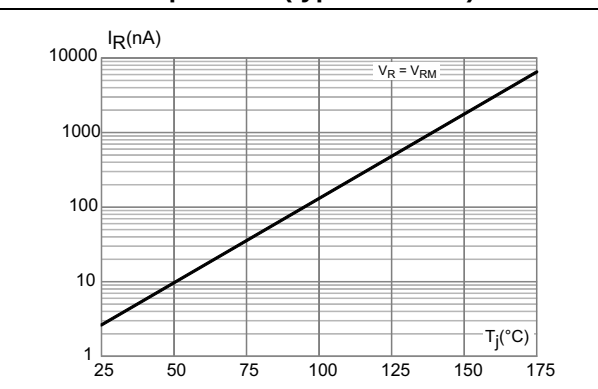
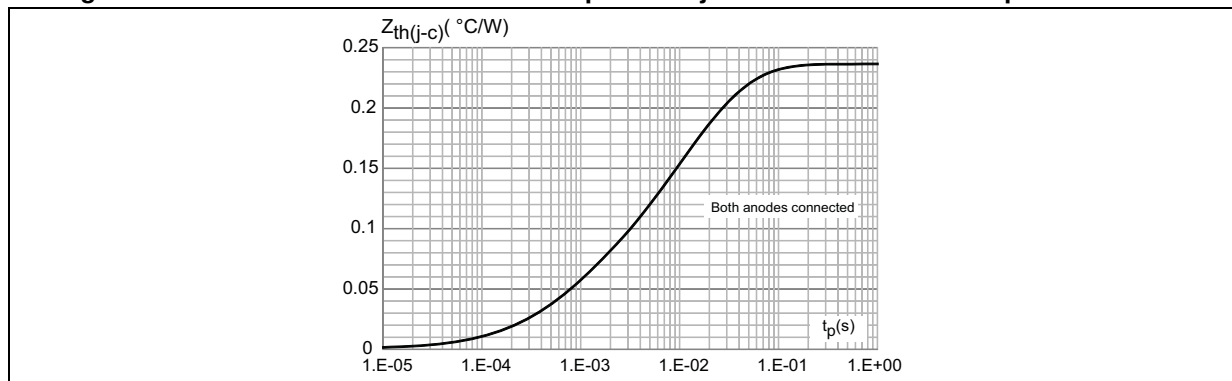


Figure 16. Leakage current versus junction temperature (typical values)



**Figure 17. Relative variation of thermal impedance junction to case versus pulse duration**

More information available in AN2689 on [www.st.com](http://www.st.com): Protection of automotive electronics from electrical hazards, guidelines for design and component selection.

## 2 Package information

- Epoxy meets UL94, V0

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**Figure 18. D<sup>2</sup>PAK dimension definitions**

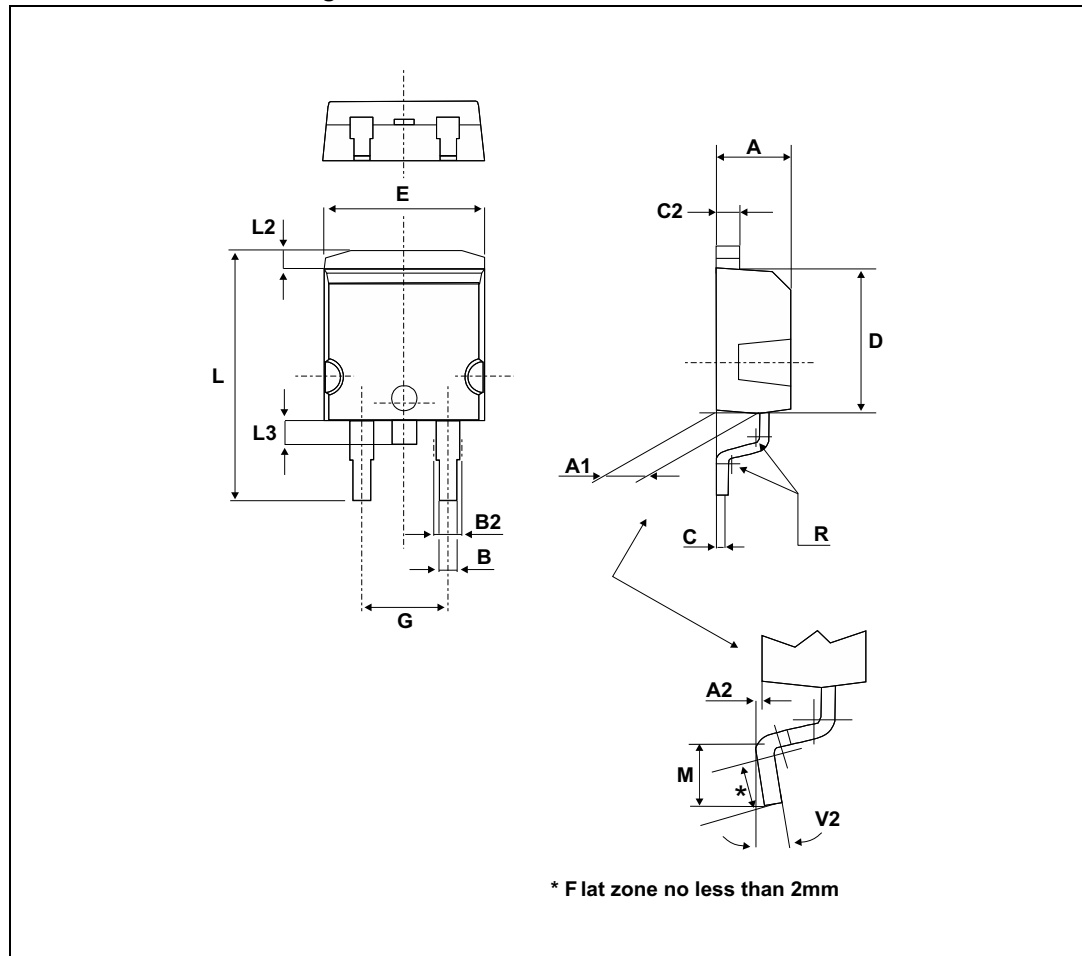


Table 5. D<sup>2</sup>PAK dimension values

| Ref. | Dimensions  |       |            |       |
|------|-------------|-------|------------|-------|
|      | Millimeters |       | Inches     |       |
|      | Min.        | Max.  | Min.       | Max.  |
| A    | 4.40        | 4.60  | 0.173      | 0.181 |
| A1   | 2.49        | 2.69  | 0.098      | 0.106 |
| A2   | 0.03        | 0.23  | 0.001      | 0.009 |
| B    | 0.70        | 0.93  | 0.027      | 0.037 |
| B2   | 1.14        | 1.70  | 0.045      | 0.067 |
| C    | 0.45        | 0.60  | 0.017      | 0.024 |
| C2   | 1.23        | 1.36  | 0.048      | 0.054 |
| D    | 8.95        | 9.35  | 0.352      | 0.368 |
| E    | 10.00       | 10.40 | 0.393      | 0.409 |
| G    | 4.88        | 5.28  | 0.192      | 0.208 |
| L    | 15.00       | 15.85 | 0.590      | 0.624 |
| L2   | 1.27        | 1.40  | 0.050      | 0.055 |
| L3   | 1.30        | 1.75  | 0.051      | 0.069 |
| M    | 2.29        | 2.79  | 0.090      | 0.110 |
| R    | 0.40 typ.   |       | 0.016 typ. |       |
| V2   | 0°          | 8°    | 0°         | 8°    |

Figure 19. Footprint (dimensions in mm)

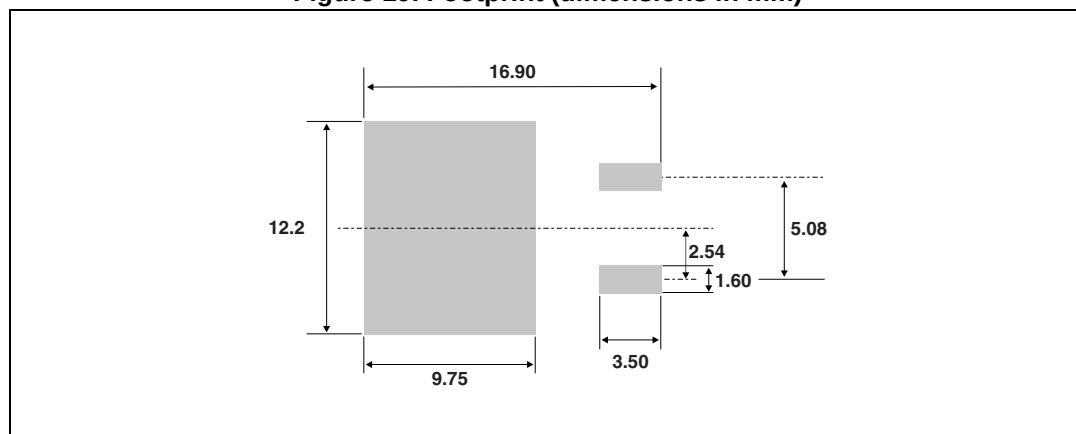
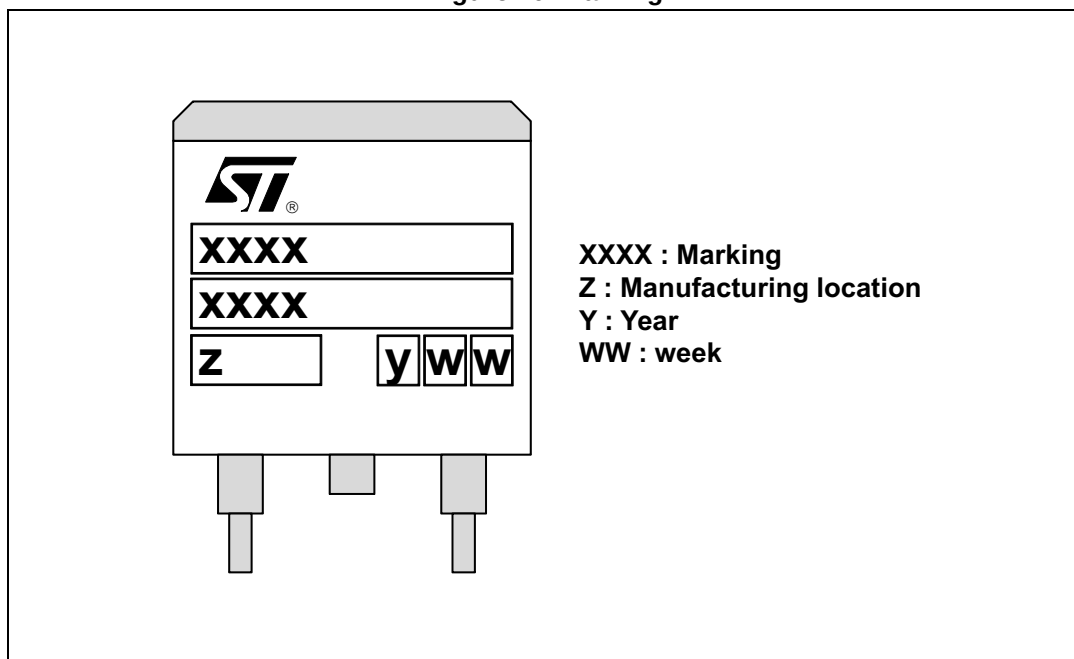




Figure 20. Marking



### 3 Ordering information

Table 6. Ordering information

| Order code | Marking    | Package            | Weight | Base qty | Delivery mode |
|------------|------------|--------------------|--------|----------|---------------|
| LDP01-26AY | LDP01-26AY | D <sup>2</sup> PAK | 1.38 g | 1000     | Tape and reel |
| LDP01-28AY | LDP01-28AY |                    |        |          |               |
| LDP01-30AY | LDP01-30AY |                    |        |          |               |
| LDP01-33AY | LDP01-33AY |                    |        |          |               |
| LDP01-35AY | LDP01-35AY |                    |        |          |               |
| LDP01-39AY | LDP01-39AY |                    |        |          |               |
| LDP01-42AY | LDP01-42AY |                    |        |          |               |
| LDP01-47AY | LDP01-47AY |                    |        |          |               |
| LDP01-50AY | LDP01-50AY |                    |        |          |               |
| LDP01-56AY | LDP01-56AY |                    |        |          |               |
| LDP01-68AY | LDP01-68AY |                    |        |          |               |
| LDP01-82AY | LDP01-82AY |                    |        |          |               |

### 4 Revision history

Table 7. Document revision history

| Date        | Revision | Changes                                                                                                                 |
|-------------|----------|-------------------------------------------------------------------------------------------------------------------------|
| 26-Nov-2014 | 1        | Initial release.                                                                                                        |
| 01-Oct-2015 | 2        | Added wildcard character in part number on the cover page.<br>Updated <a href="#">Figure 4</a> .<br>Minor text changes. |

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