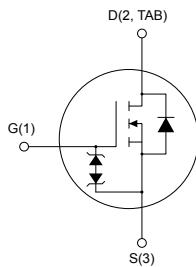


## N-channel 500 V, 2.2 $\Omega$ typ., 3 A SuperMESH™ Power MOSFETs in IPAK and DPAK packages



AM01479V1

### Features

| Order codes | $V_{DS}$ | $R_{DS(on)}$ max. | $P_{TOT}$ | Package |
|-------------|----------|-------------------|-----------|---------|
| STD4NK50Z-1 | 500 V    | 2.7 $\Omega$      | 45 W      | IPAK    |
| STD4NK50ZT4 |          |                   |           | DPAK    |

- Extremely high dv/dt capability
- 100% avalanche tested
- Gate charge minimized
- Very low intrinsic capacitance
- Zener-protected

### Applications

- Switching applications

### Description

These high-voltage devices are Zener-protected N-channel Power MOSFETs developed using the SuperMESH™ technology by STMicroelectronics, an optimization of the well-established PowerMESH™. In addition to a significant reduction in on-resistance, these devices are designed to ensure a high level of dv/dt capability for the most demanding applications.

#### Product status link

[STD4NK50Z-1](#)
[STD4NK50ZT4](#)

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

| Symbol         | Parameter   | Value      | Unit             |
|----------------|---|------------|------------------|
| $V_{DS}$       | Drain-source voltage  | 500        | V                |
| $V_{GS}$       | Gate-source voltage   | $\pm 30$   | V                |
| $I_D$          | Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$                  | 3          | A                |
| $I_D$          | Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$                 | 1.9        | A                |
| $I_{DM}^{(1)}$ | Drain current (pulsed)  | 12         | A                |
| $P_{TOT}$      | Total dissipation at $T_C = 25\text{ }^\circ\text{C}$                           | 45         | W                |
| $dv/dt^{(2)}$  | Peak diode recovery voltage slope   | 4.5        | V/ns             |
| ESD            | Gate-source human body model ( $C = 100\text{ pF}$ , $R = 1.5\text{ k}\Omega$ ) | 2.8        | kV               |
| $T_j$          | Operating junction temperature range  | -55 to 150 | $^\circ\text{C}$ |
| $T_{stg}$      | Storage temperature range   |            |                  |

1. Pulse width limited by safe operating area.

2.  $I_{SD} \leq 3\text{ A}$ ,  $di/dt \leq 200\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq V_{(BR)DSS}$ .

**Table 2. Thermal data**

| Symbol              | Parameter                           | Value |      | Unit                      |
|---------------------|-------------------------------------|-------|------|---------------------------|
|                     |                                     | IPAK  | DPAK |                           |
| $R_{thj-case}$      | Thermal resistance junction-case    | 2.78  |      | $^\circ\text{C}/\text{W}$ |
| $R_{thj-amb}$       | Thermal resistance junction-ambient | 100   |      | $^\circ\text{C}/\text{W}$ |
| $R_{thj-pcb}^{(1)}$ | Thermal resistance junction-pcb     |       | 50   | $^\circ\text{C}/\text{W}$ |

1. When mounted on an 1-inch<sup>2</sup> FR-4, 2oz Cu board.

**Table 3. Avalanche characteristics**

| Symbol   | Parameter  | Value | Unit |
|----------|--|-------|------|
| $I_{AR}$ | Avalanche current, repetitive or not-repetitive (pulse width limited by $T_j$ max)                                   | 3     | A    |
| $E_{AS}$ | Single pulse avalanche energy (starting $T_j = 25\text{ }^\circ\text{C}$ , $I_D = I_{AR}$ , $V_{DD} = 50\text{ V}$ ) | 120   | mJ   |

## 2 Electrical characteristics

( $T_{CASE} = 25\text{ °C}$  unless otherwise specified)

**Table 4. On/off states**

| Symbol        | Parameter                         | Test conditions   | Min. | Typ. | Max.     | Unit          |
|---------------|-----------------------------------|---|------|------|----------|---------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage    | $V_{GS} = 0\text{ V}$ , $I_D = 1\text{ mA}$   | 500  |      |          | V             |
| $I_{DSS}$     | Zero gate voltage drain current   | $V_{GS} = 0\text{ V}$ , $V_{DS} = 500\text{ V}$   |      |      | 1        | $\mu\text{A}$ |
|               |                                   | $V_{GS} = 0\text{ V}$ , $V_{DS} = 500\text{ V}$ ,<br>$T_C = 125\text{ °C}$ <sup>(1)</sup> |      |      | 50       | $\mu\text{A}$ |
| $I_{GSS}$     | Gate-body leakage current         | $V_{DS} = 0\text{ V}$ , $V_{GS} = \pm 20\text{ V}$  |      |      | $\pm 10$ | $\mu\text{A}$ |
| $V_{GS(th)}$  | Gate threshold voltage            | $V_{DS} = V_{GS}$ , $I_D = 50\text{ }\mu\text{A}$   | 3    | 3.75 | 4.5      | V             |
| $R_{DS(on)}$  | Static drain-source on resistance | $V_{GS} = 10\text{ V}$ , $I_D = 1.5\text{ A}$   |      | 2.2  | 2.7      | $\Omega$      |

1. Defined by design, not subject to production test.

**Table 5. Dynamic**

| Symbol                     | Parameter                     | Test conditions   | Min. | Typ. | Max. | Unit |
|----------------------------|-------------------------------|---|------|------|------|------|
| $C_{iss}$                  | Input capacitance             | $V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$ ,<br>$V_{GS} = 0\text{ V}$  | -    | 310  |      | pF   |
| $C_{oss}$                  | Output capacitance            |   |      | 49   |      |      |
| $C_{rss}$                  | Reverse transfer capacitance  |   |      | 10   |      |      |
| $C_{oss\text{ eq.}}^{(1)}$ | Equivalent output capacitance | $V_{GS} = 0\text{ V}$ , $V_{DS} = 0\text{ V to } 400\text{ V}$  | -    | 33   |      |      |
| $Q_g$                      | Total gate charge             | $V_{DD} = 400\text{ V}$ , $I_D = 3\text{ A}$ ,<br>$V_{GS} = 0\text{ to } 10\text{ V}$<br>(see Figure 14. Test circuit for gate charge behavior) | -    | 12   |      | nC   |
| $Q_{gs}$                   | Gate-source charge            |   |      | 3    |      |      |
| $Q_{gd}$                   | Gate-drain charge             |   |      | 7    |      |      |

1.  $C_{oss\text{ eq.}}$  is defined as a constant equivalent capacitance giving the same charging time as  $C_{oss}$  when  $V_{DS}$  increases from 0 to 80%  $V_{DSS}$ .

**Table 6. Switching times**

| Symbol       | Parameter           | Test conditions   | Min. | Typ. | Max. | Unit |
|--------------|---------------------|---|------|------|------|------|
| $t_{d(on)}$  | Turn-on delay time  | $V_{DD} = 250\text{ V}$ , $I_D = 1.5\text{ A}$ ,<br>$R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$  |      | 10   |      | ns   |
| $t_r$        | Rise time           |   |      | 7    |      |      |
| $t_{d(off)}$ | Turn-off delay time | (see Figure 13. Test circuit for resistive load switching times and Figure 18. Switching time waveform) | -    | 21   |      | ns   |
| $t_f$        | Fall time           |   |      | 11   |      |      |

**Table 7. Source-drain diode**

| Symbol          | Parameter                     | Test conditions  | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|--|------|------|------|------|
| $I_{SD}$        | Source-drain current          |  | -    |      | 3    | A    |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) |  | -    |      | 12   |      |
| $V_{SD}^{(2)}$  | Forward on voltage            | $I_{SD} = 3\text{ A}$ , $V_{GS} = 0\text{ V}$  | -    |      | 1.6  | V    |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 3\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$   | -    | 260  |      | ns   |
| $Q_{rr}$        | Reverse recovery charge       | $V_{DD} = 40\text{ V}$ , $T_j = 150\text{ }^\circ\text{C}$   | -    | 935  |      | nC   |
| $I_{RRM}$       | Reverse recovery current      | (see <a href="#">Figure 15. Test circuit for inductive load switching and diode recovery times</a> ) | -    | 7.2  |      | A    |

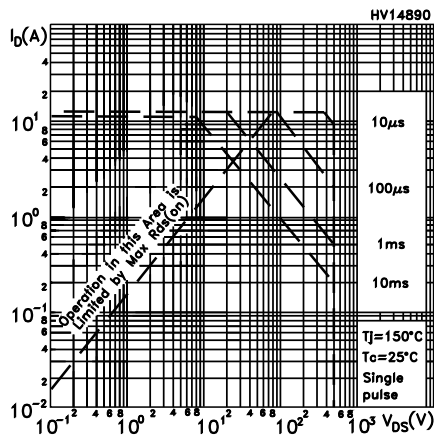
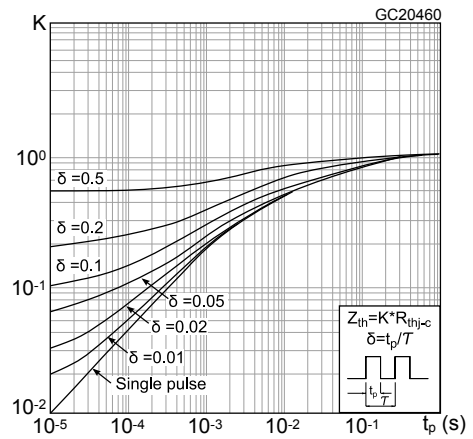
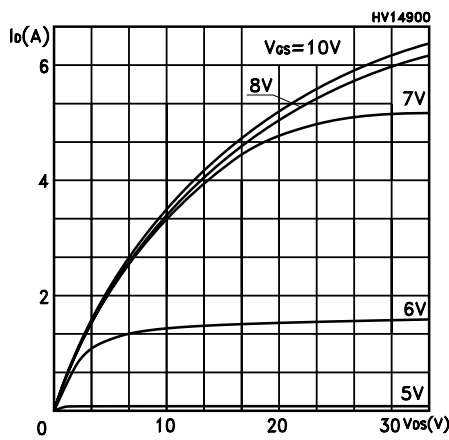
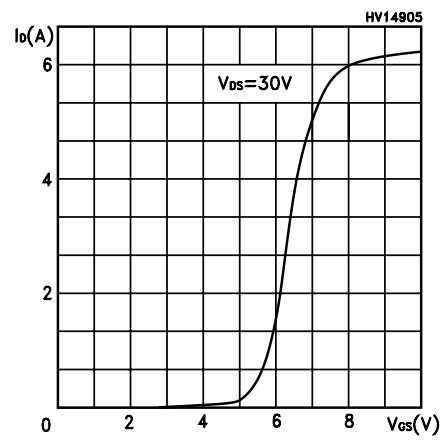
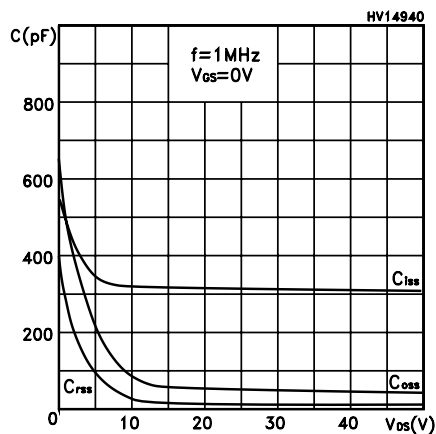
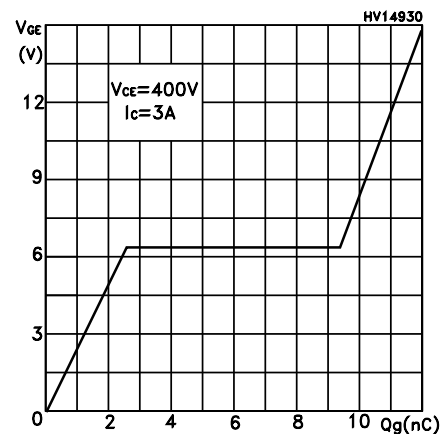
1. Pulse width limited by safe operating area.

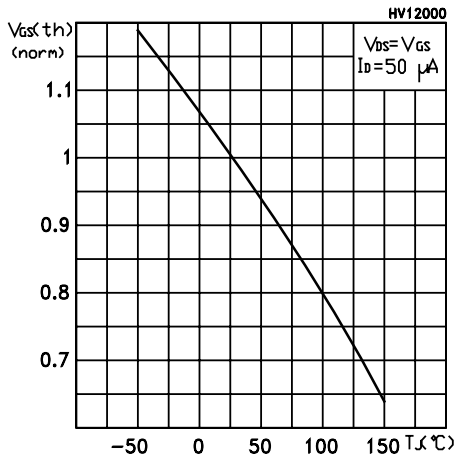
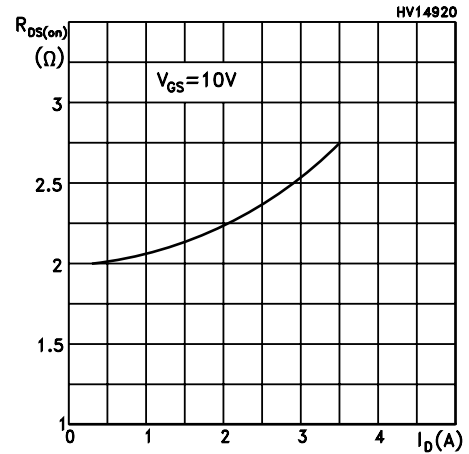
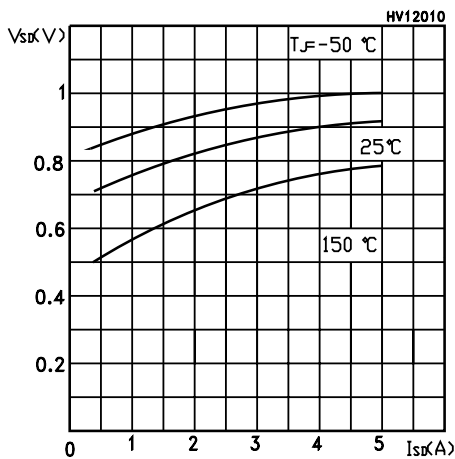
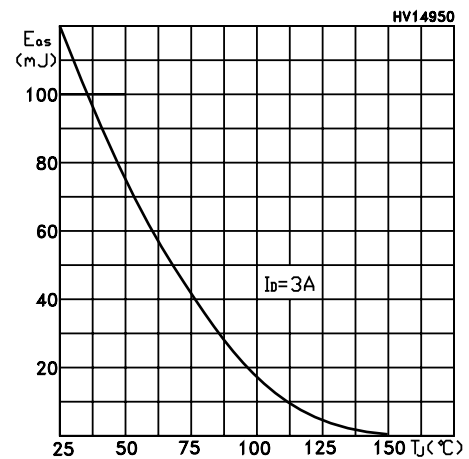
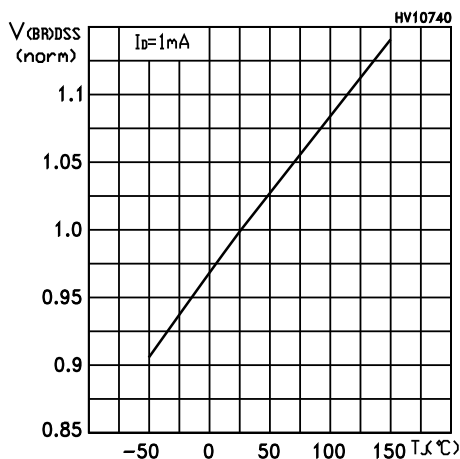
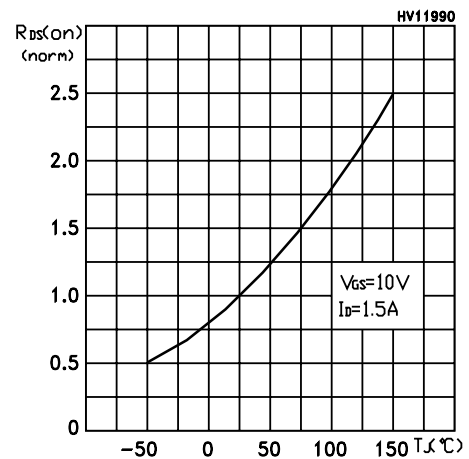
2. Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5 %.

**Table 8. Gate-source Zener diode**

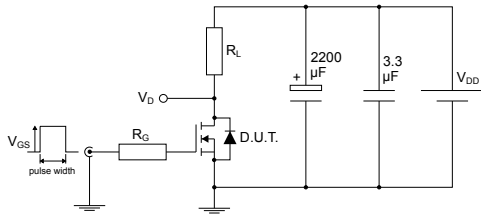
| Symbol        | Parameter                     | Test conditions                                 | Min.     | Typ. | Max. | Unit |
|---------------|-------------------------------|---|----------|------|------|------|
| $V_{(BR)GSO}$ | Gate-source breakdown voltage | $I_{GS} = \pm 1\text{ mA}$ , $I_D = 0\text{ A}$ | $\pm 30$ | -    | -    | V    |

The built-in back-to-back Zener diodes are specifically designed to enhance the ESD performance of the device. The Zener voltage facilitates efficient and cost-effective device integrity protection, thus eliminating the need for additional external componentry.

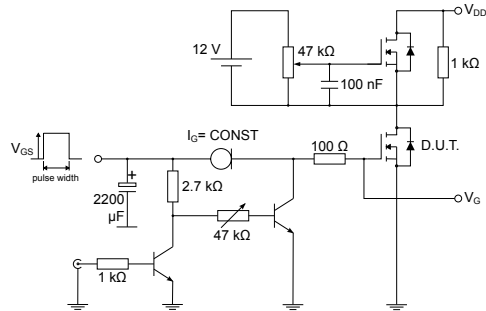
**2.1 Electrical characteristics (curves)**
**Figure 1. Safe operating area**

**Figure 2. Thermal impedance**

**Figure 3. Output characteristics**

**Figure 4. Transfer characteristics**

**Figure 5. Capacitance variations**

**Figure 6. Gate charge vs gate-source voltage**


**Figure 7. Normalized gate threshold voltage vs temperature**

**Figure 8. Static drain-source on resistance**

**Figure 9. Source-drain diode forward characteristic**

**Figure 10. Maximum avalanche energy vs temperature**

**Figure 11. Normalized  $V_{(BR)DSS}$  vs temperature**

**Figure 12. Normalized on resistance vs temperature**


### 3 Test circuits

**Figure 13. Test circuit for resistive load switching times**


AM01468v1

**Figure 14. Test circuit for gate charge behavior**


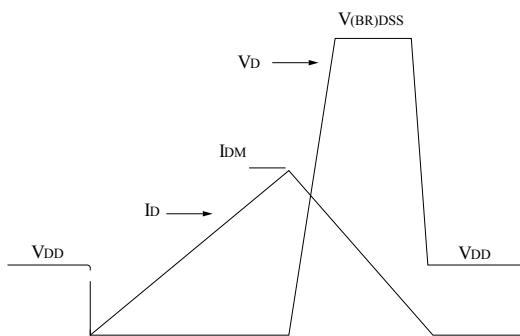
AM01469v1

**Figure 15. Test circuit for inductive load switching and diode recovery times**


AM01470v1

**Figure 16. Unclamped inductive load test circuit**


AM01471v1

**Figure 17. Unclamped inductive waveform**


AM01472v1

**Figure 18. Switching time waveform**


AM01473v1

## 4 Package information

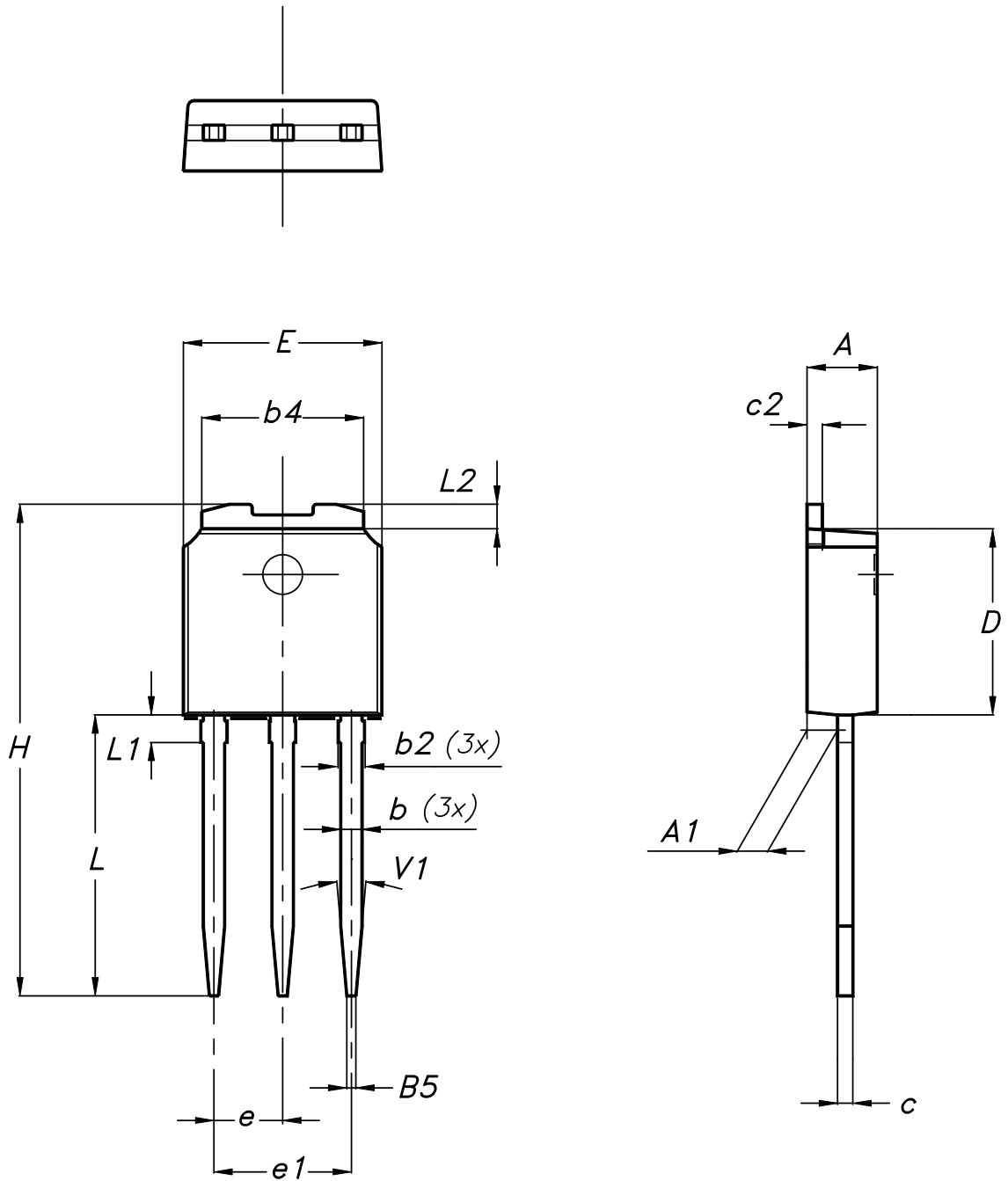
---

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK® is an ST trademark.



#### 4.1 IPAK (TO-251) type A package information

Figure 19. IPAK (TO-251) type A package outline



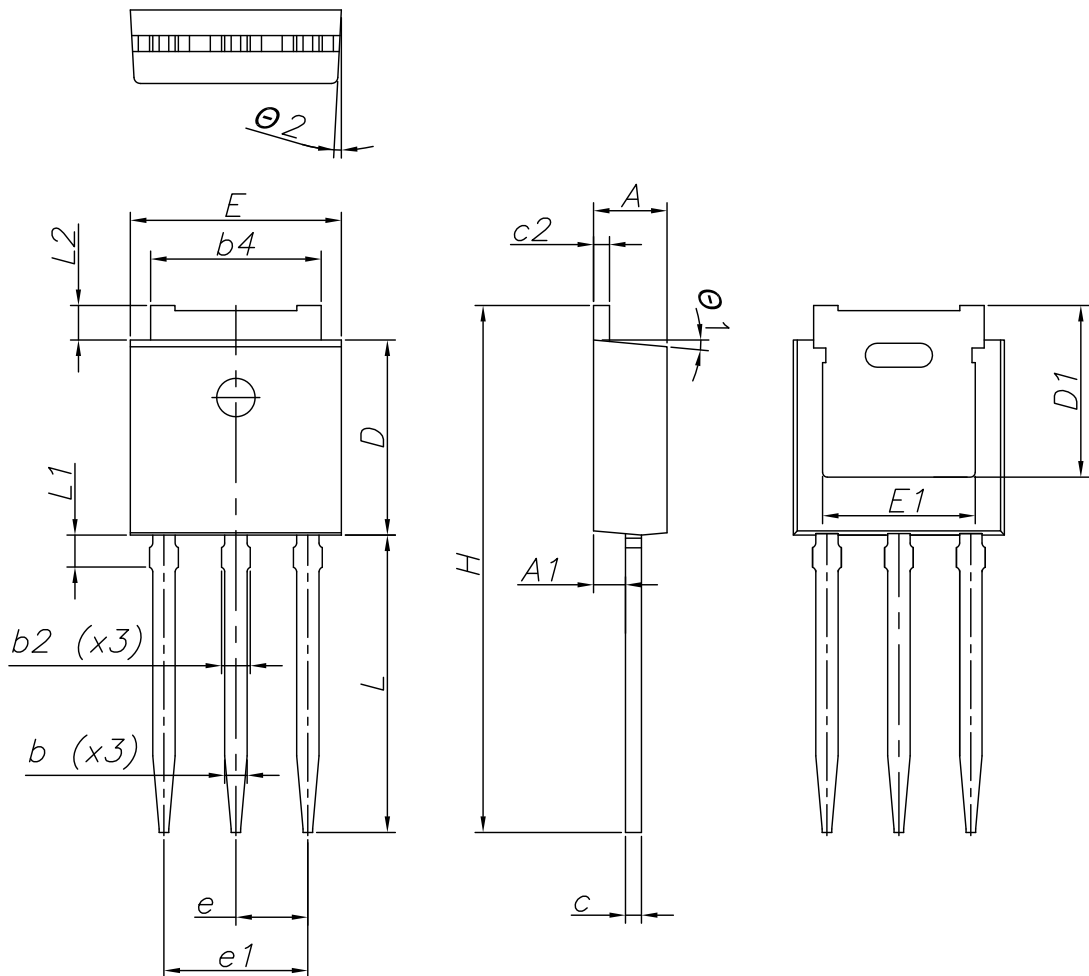
0068771\_IK\_typeA\_rev14

**Table 9. IPAK (TO-251) type A package mechanical data**

| Dim. | mm   |       |      |
|------|------|-------|------|
|      | Min. | Typ.  | Max. |
| A    | 2.20 |       | 2.40 |
| A1   | 0.90 |       | 1.10 |
| b    | 0.64 |       | 0.90 |
| b2   |      |       | 0.95 |
| b4   | 5.20 |       | 5.40 |
| B5   |      | 0.30  |      |
| c    | 0.45 |       | 0.60 |
| c2   | 0.48 |       | 0.60 |
| D    | 6.00 |       | 6.20 |
| E    | 6.40 |       | 6.60 |
| e    |      | 2.28  |      |
| e1   | 4.40 |       | 4.60 |
| H    |      | 16.10 |      |
| L    | 9.00 |       | 9.40 |
| L1   | 0.80 |       | 1.20 |
| L2   |      | 0.80  | 1.00 |
| V1   |      | 10°   |      |

## 4.2 IPAK (TO-251) type C package information

Figure 20. IPAK (TO-251) type C package outline



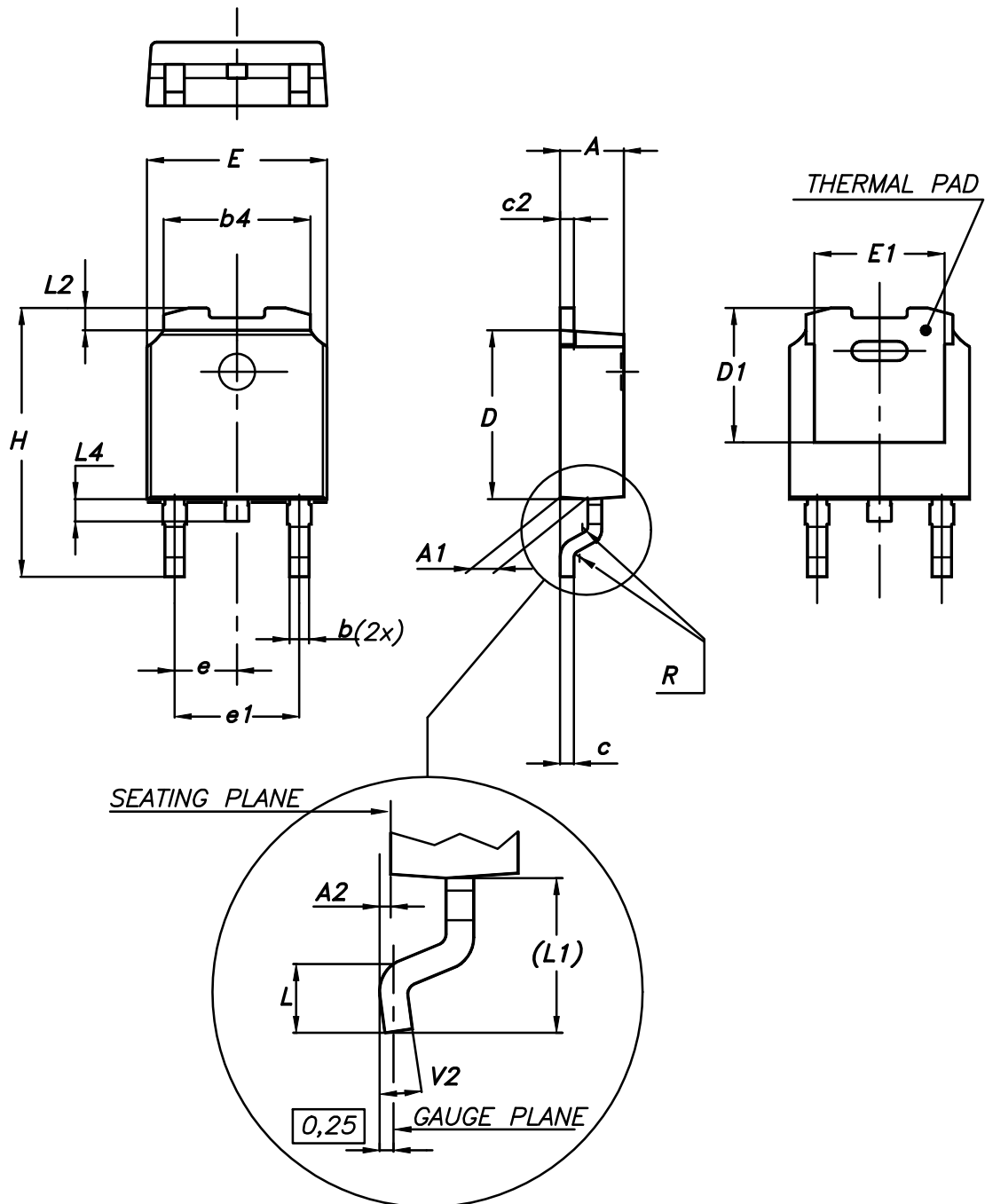
0068771\_IK\_typeC\_rev14

**Table 10. IPAK (TO-251) type C package mechanical data**

| Dim. | mm    |       |       |
|------|-------|-------|-------|
|      | Min.  | Typ.  | Max.  |
| A    | 2.20  | 2.30  | 2.35  |
| A1   | 0.90  | 1.00  | 1.10  |
| b    | 0.66  |       | 0.79  |
| b2   |       |       | 0.90  |
| b4   | 5.23  | 5.33  | 5.43  |
| c    | 0.46  |       | 0.59  |
| c2   | 0.46  |       | 0.59  |
| D    | 6.00  | 6.10  | 6.20  |
| D1   | 5.20  | 5.37  | 5.55  |
| E    | 6.50  | 6.60  | 6.70  |
| E1   | 4.60  | 4.78  | 4.95  |
| e    | 2.20  | 2.25  | 2.30  |
| e1   | 4.40  | 4.50  | 4.60  |
| H    | 16.18 | 16.48 | 16.78 |
| L    | 9.00  | 9.30  | 9.60  |
| L1   | 0.80  | 1.00  | 1.20  |
| L2   | 0.90  | 1.08  | 1.25  |
| θ1   | 3°    | 5°    | 7°    |
| θ2   | 1°    | 3°    | 5°    |

**4.3 DPAK (TO-252) type A package information**

Figure 21. DPAK (TO-252) type A package outline



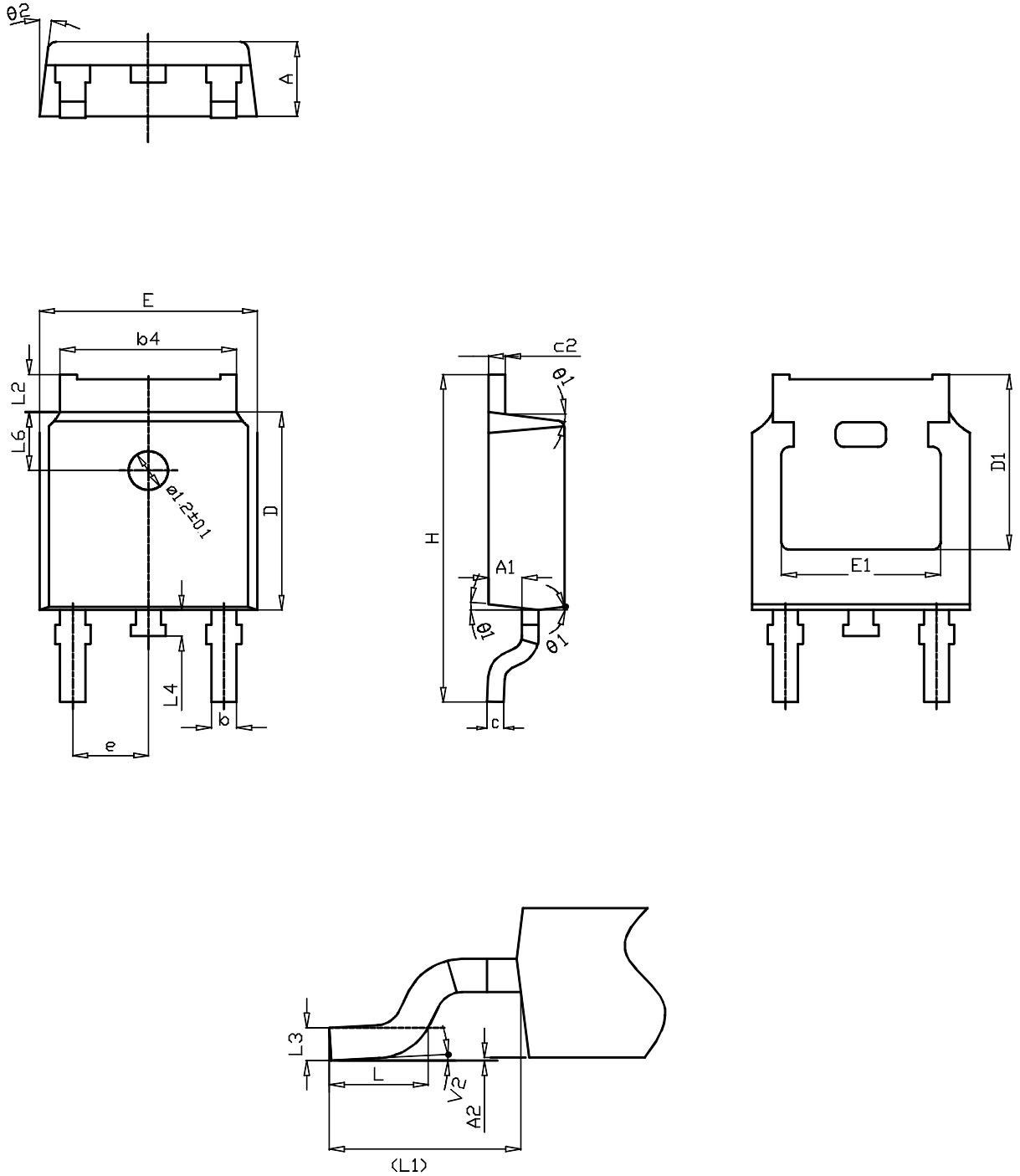
0068772\_A\_25

**Table 11. DPAK (TO-252) type A mechanical data**

| Dim. | mm    |       |       |
|------|-------|-------|-------|
|      | Min.  | Typ.  | Max.  |
| A    | 2.20  |       | 2.40  |
| A1   | 0.90  |       | 1.10  |
| A2   | 0.03  |       | 0.23  |
| b    | 0.64  |       | 0.90  |
| b4   | 5.20  |       | 5.40  |
| c    | 0.45  |       | 0.60  |
| c2   | 0.48  |       | 0.60  |
| D    | 6.00  |       | 6.20  |
| D1   | 4.95  | 5.10  | 5.25  |
| E    | 6.40  |       | 6.60  |
| E1   | 4.60  | 4.70  | 4.80  |
| e    | 2.159 | 2.286 | 2.413 |
| e1   | 4.445 | 4.572 | 4.699 |
| H    | 9.35  |       | 10.10 |
| L    | 1.00  |       | 1.50  |
| (L1) | 2.60  | 2.80  | 3.00  |
| L2   | 0.65  | 0.80  | 0.95  |
| L4   | 0.60  |       | 1.00  |
| R    |       | 0.20  |       |
| V2   | 0°    |       | 8°    |

#### 4.4 DPAK (TO-252) type C package information

Figure 22. DPAK (TO-252) type C package outline



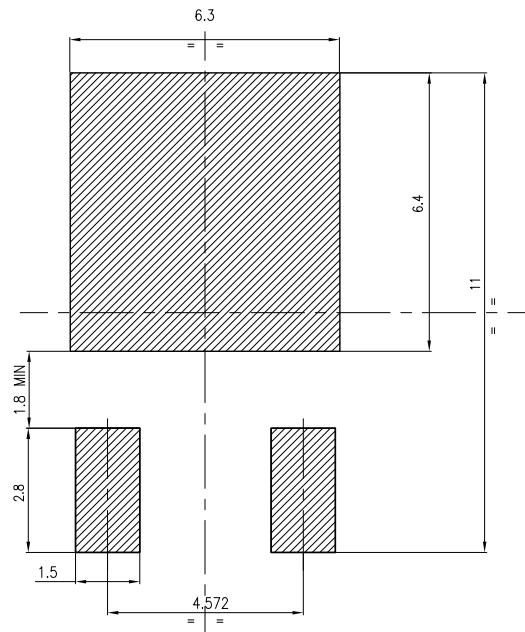
0068772\_C\_25

**Table 12. DPAK (TO-252) type C mechanical data**

| Dim. | mm       |       |       |
|------|----------|-------|-------|
|      | Min.     | Typ.  | Max.  |
| A    | 2.20     | 2.30  | 2.38  |
| A1   | 0.90     | 1.01  | 1.10  |
| A2   | 0.00     |       | 0.10  |
| b    | 0.72     |       | 0.85  |
| b4   | 5.13     | 5.33  | 5.46  |
| c    | 0.47     |       | 0.60  |
| c2   | 0.47     |       | 0.60  |
| D    | 6.00     | 6.10  | 6.20  |
| D1   | 5.25     |       |       |
| E    | 6.50     | 6.60  | 6.70  |
| E1   | 4.70     |       |       |
| e    | 2.186    | 2.286 | 2.386 |
| H    | 9.80     | 10.10 | 10.40 |
| L    | 1.40     | 1.50  | 1.70  |
| L1   | 2.90 REF |       |       |
| L2   | 0.90     |       | 1.25  |
| L3   | 0.51 BSC |       |       |
| L4   | 0.60     | 0.80  | 1.00  |
| L6   | 1.80 BSC |       |       |
| θ1   | 5°       | 7°    | 9°    |
| θ2   | 5°       | 7°    | 9°    |
| V2   | 0°       |       | 8°    |



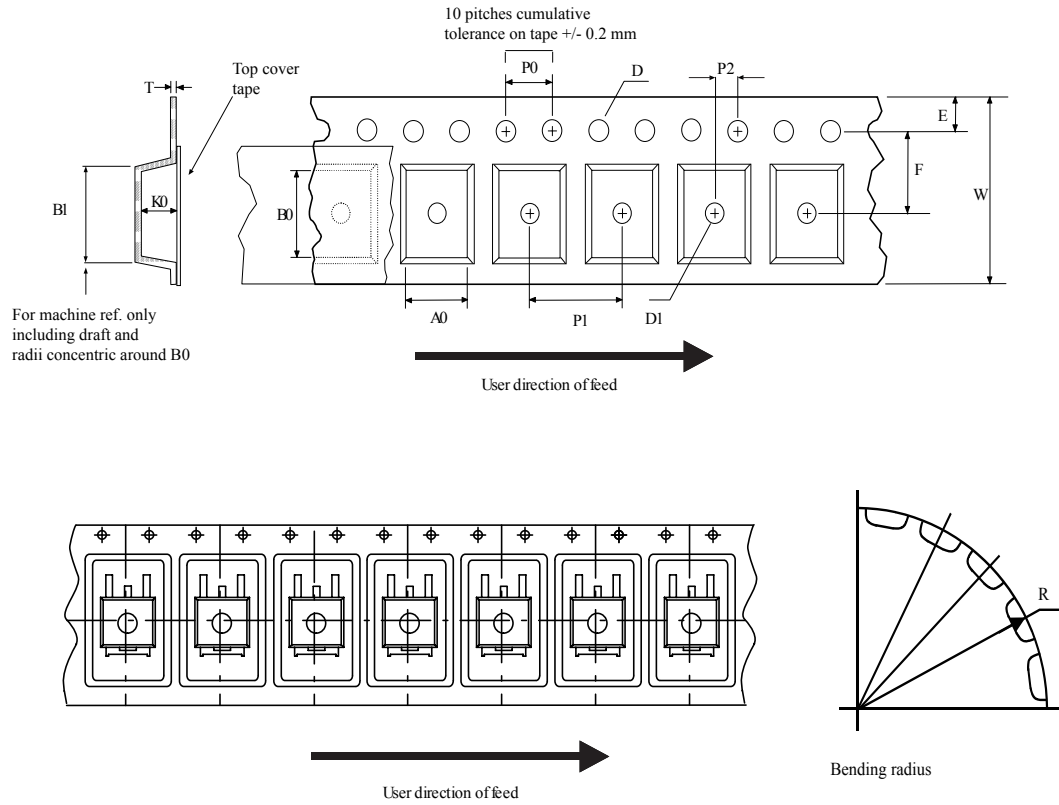
Figure 23. DPAK (TO-252) recommended footprint (dimensions are in mm)



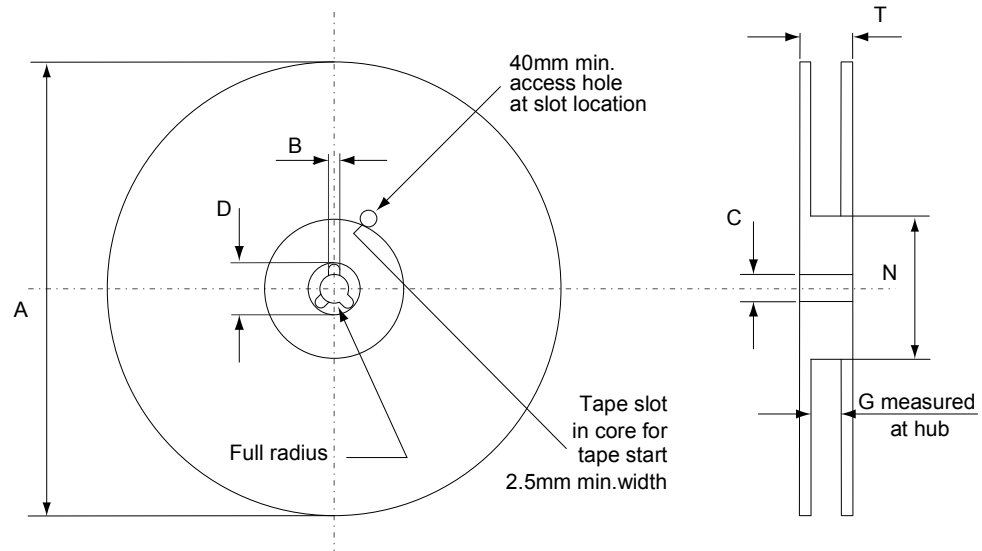
FP\_0068772\_25\_C

### 4.5 DPAK (TO-252) packing information

Figure 24. DPAK (TO-252) tape outline



AM08852v1

**Figure 25. DPAK (TO-252) reel outline**


AM06038v1

**Table 13. DPAK (TO-252) tape and reel mechanical data**

| Tape |      |      | Reel      |      |      |
|------|------|------|-----------|------|------|
| Dim. | mm   |      | Dim.      | mm   |      |
|      | Min. | Max. |           | Min. | Max. |
| A0   | 6.8  | 7    | A         |      | 330  |
| B0   | 10.4 | 10.6 | B         | 1.5  |      |
| B1   |      | 12.1 | C         | 12.8 | 13.2 |
| D    | 1.5  | 1.6  | D         | 20.2 |      |
| D1   | 1.5  |      | G         | 16.4 | 18.4 |
| E    | 1.65 | 1.85 | N         | 50   |      |
| F    | 7.4  | 7.6  | T         |      | 22.4 |
| K0   | 2.55 | 2.75 |           |      |      |
| P0   | 3.9  | 4.1  | Base qty. |      | 2500 |
| P1   | 7.9  | 8.1  | Bulk qty. |      | 2500 |
| P2   | 1.9  | 2.1  |           |      |      |
| R    | 40   |      |           |      |      |
| T    | 0.25 | 0.35 |           |      |      |
| W    | 15.7 | 16.3 |           |      |      |

## 5 Ordering information

Table 14. Order codes

| Order code  | Marking | Package | Packing       |
|-------------|---------|---------|---------------|
| STD4NK50Z-1 | D4NK50Z | IPAK    | Tube          |
| STD4NK50ZT4 |         | DPAK    | Tape and reel |

## Revision history

**Table 15. Document revision history**

| Date        | Version | Changes   |
|-------------|---------|---|
| 09-Dec-2002 | 2       | Updated document.   |
| 20-Aug-2018 | 3       | <p>Removed maturity status indication from cover page. The document status is production data.</p> <p>The part numbers STP4NK50Z and STP4NK50FP have been moved to a separate datasheet.</p> <p>Updated <a href="#">Section 1 Electrical ratings</a>, <a href="#">Section 2 Electrical characteristics</a> and <a href="#">Section 4 Package information</a>.</p> <p>Added <a href="#">Section 5 Ordering information</a>.</p> <p>Minor text changes.</p> |

## Contents

|            |  |           |
|------------|--|-----------|
| <b>1</b>   | <b>Electrical ratings</b> .....                | <b>2</b>  |
| <b>2</b>   | <b>Electrical characteristics</b> .....        | <b>3</b>  |
| <b>2.1</b> | Electrical characteristics (curves) .....      | 5         |
| <b>3</b>   | <b>Test circuits</b> .....                     | <b>7</b>  |
| <b>4</b>   | <b>Package information</b> .....               | <b>8</b>  |
| <b>4.1</b> | IPAK (TO-251) type A package information ..... | 8         |
| <b>4.2</b> | IPAK (TO-251) type C package information ..... | 10        |
| <b>4.3</b> | DPAK (TO-252) type A package information ..... | 12        |
| <b>4.4</b> | DPAK (TO-252) type C package information ..... | 14        |
| <b>4.5</b> | DPAK (TO-252) packing information .....        | 17        |
| <b>5</b>   | <b>Ordering information</b> .....              | <b>20</b> |
|            | <b>Revision history</b> .....                  | <b>21</b> |

**IMPORTANT NOTICE – PLEASE READ CAREFULLY**

STMicroelectronics NV and its subsidiaries (“ST”) reserve the right to make changes, corrections, enhancements, modifications, and improvements to ST products and/or to this document at any time without notice. Purchasers should obtain the latest relevant information on ST products before placing orders. ST products are sold pursuant to ST’s terms and conditions of sale in place at the time of order acknowledgement.

Purchasers are solely responsible for the choice, selection, and use of ST products and ST assumes no liability for application assistance or the design of Purchasers’ products.

No license, express or implied, to any intellectual property right is granted by ST herein.

Resale of ST products with provisions different from the information set forth herein shall void any warranty granted by ST for such product.

ST and the ST logo are trademarks of ST. All other product or service names are the property of their respective owners.

Information in this document supersedes and replaces information previously supplied in any prior versions of this document.

© 2018 STMicroelectronics – All rights reserved

## Данный компонент на территории Российской Федерации

### Вы можете приобрести в компании MosChip.

Для оперативного оформления запроса Вам необходимо перейти по данной ссылке:

<http://moschip.ru/get-element>

Вы можете разместить у нас заказ для любого Вашего проекта, будь то серийное производство или разработка единичного прибора.

В нашем ассортименте представлены ведущие мировые производители активных и пассивных электронных компонентов.

Нашей специализацией является поставка электронной компонентной базы двойного назначения, продукции таких производителей как XILINX, Intel (ex.ALTERA), Vicor, Microchip, Texas Instruments, Analog Devices, Mini-Circuits, Amphenol, Glenair.

Сотрудничество с глобальными дистрибьюторами электронных компонентов, предоставляет возможность заказывать и получать с международных складов практически любой перечень компонентов в оптимальные для Вас сроки.

На всех этапах разработки и производства наши партнеры могут получить квалифицированную поддержку опытных инженеров.

Система менеджмента качества компании отвечает требованиям в соответствии с ГОСТ Р ИСО 9001, ГОСТ РВ 0015-002 и ЭС РД 009

### Офис по работе с юридическими лицами:

105318, г.Москва, ул.Щербаковская д.3, офис 1107, 1118, ДЦ «Щербаковский»

Телефон: +7 495 668-12-70 (многоканальный)

Факс: +7 495 668-12-70 (доб.304)

E-mail: [info@moschip.ru](mailto:info@moschip.ru)

Skype отдела продаж:

moschip.ru

moschip.ru\_4

moschip.ru\_6

moschip.ru\_9