



# STB18NM60N, STF18NM60N, STP18NM60N, STW18NM60N

N-channel 600 V, 0.26  $\Omega$  typ., 13 A MDmesh™ II Power MOSFET  
in D<sup>2</sup>PAK, TO-220FP, TO-220 and TO-247

Datasheet — production data

## Features

| Order codes | V <sub>DSS</sub><br>(@T <sub>jmax</sub> ) | R <sub>DS(on)</sub><br>max. | I <sub>D</sub> | P <sub>TOT</sub> |
|-------------|-------------------------------------------|-----------------------------|----------------|------------------|
| STB18NM60N  | 650 V                                     | < 0.285 $\Omega$            | 13 A           | 110 W            |
| STF18NM60N  |                                           |                             |                | 30 W             |
| STP18NM60N  |                                           |                             |                | 110              |
| STW18NM60N  |                                           |                             |                |                  |

- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance

## Applications

- Switching applications

## Description

These devices are N-channel Power MOSFETs developed using the second generation of MDmesh™ technology. This revolutionary Power MOSFET associates a vertical structure to the company's strip layout to yield one of the world's lowest on-resistance and gate charge. It is therefore suitable for the most demanding high efficiency converters.

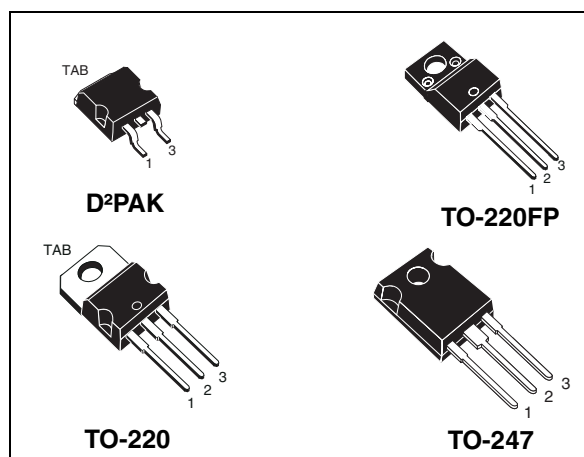


Figure 1. Internal schematic diagram

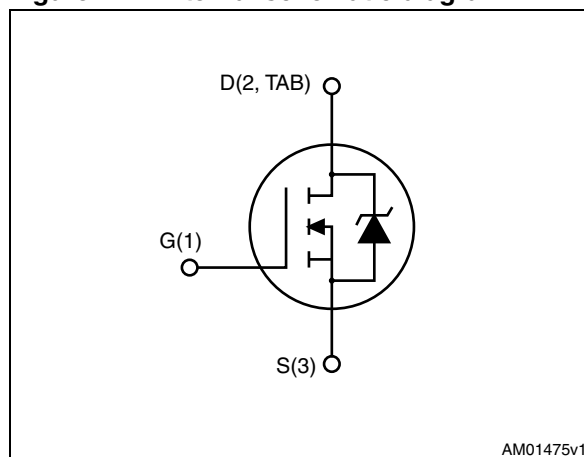


Table 1. Device summary

| Order codes | Marking | Package            | Packaging     |
|-------------|---------|--------------------|---------------|
| STB18NM60N  | 18NM60N | D <sup>2</sup> PAK | Tape and reel |
| STF18NM60N  | 18NM60N | TO-220FP           | Tube          |
| STP18NM60N  | 18NM60N | TO-220             | Tube          |
| STW18NM60N  | 18NM60N | TO-247             | Tube          |

Contents

1      **Electrical ratings** ..... 3

2      **Electrical characteristics** ..... 4

      2.1    Electrical characteristics (curves) ..... 6

3      **Test circuits** ..... 9

4      **Package mechanical data** ..... 10

5      **Packaging mechanical data** ..... 18

6      **Revision history** ..... 20



# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol                             | Parameter                                                                                                                     | Value                                |                    | Unit |
|------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|--------------------|------|
|                                    |                                                                                                                               | D <sup>2</sup> PAK,<br>TO-220,TO-247 | TO-220FP           |      |
| V <sub>DS</sub>                    | Drain-source voltage                                                                                                          | 600                                  |                    | V    |
| V <sub>GS</sub>                    | Gate- source voltage                                                                                                          | ± 25                                 |                    |      |
| I <sub>D</sub>                     | Drain current (continuous) at T <sub>C</sub> = 25 °C                                                                          | 13                                   | 13 <sup>(1)</sup>  | A    |
| I <sub>D</sub>                     | Drain current (continuous) at T <sub>C</sub> = 100 °C                                                                         | 8.2                                  | 8.2 <sup>(1)</sup> | A    |
| I <sub>DM</sub> <sup>(2)</sup>     | Drain current (pulsed)                                                                                                        | 52                                   | 52 <sup>(1)</sup>  | A    |
| P <sub>TOT</sub>                   | Total dissipation at T <sub>C</sub> = 25 °C                                                                                   | 110                                  | 30                 | W    |
| I <sub>AR</sub>                    | Avalanche current, repetitive or not-repetitive<br>(pulse width limited by T <sub>J</sub> max)                                | 4.5                                  |                    | A    |
| E <sub>AS</sub>                    | Single pulse avalanche energy<br>(starting T <sub>J</sub> = 25 °C, I <sub>D</sub> = I <sub>AR</sub> , V <sub>DD</sub> = 50 V) | 350                                  |                    | mJ   |
| dv/dt <sup>(3)</sup>               | Peak diode recovery voltage slope                                                                                             | 15                                   |                    | V/ns |
| V <sub>ISO</sub>                   | Insulation withstand voltage (RMS) from all<br>three leads to external heat sink<br>(t=1 s;T <sub>C</sub> =25 °C)             |                                      | 2500               | V    |
| T <sub>J</sub><br>T <sub>stg</sub> | Operating junction temperature<br>Storage temperature                                                                         | -55 to 150                           |                    | °C   |

1. Limited by maximum junction temperature.

2. Pulse width limited by safe operating area.

3. I<sub>SD</sub> ≤ 13 A, di/dt ≤ 400 A/μs, V<sub>DD</sub> ≤ 80 % V<sub>(BR)DSS</sub>, V<sub>DS(peak)</sub> ≤ V<sub>(BR)DSS</sub>

**Table 3. Thermal data**

| Symbol                              | Parameter                            | D <sup>2</sup> PAK | TO-220 | TO-247 | TO-220FP | Unit |
|-------------------------------------|--------------------------------------|--------------------|--------|--------|----------|------|
| R <sub>thj-case</sub>               | Thermal resistance junction-case max | 1.14               |        |        | 4.17     | °C/W |
| R <sub>thj-amb</sub>                | Thermal resistance junction-amb max  |                    | 62.5   | 50     | 62.5     |      |
| R <sub>thj-pcb</sub> <sup>(1)</sup> | Thermal resistance junction-pcb max  | 30                 |        |        |          |      |

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

## 2 Electrical characteristics

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

**Table 4. On/off states**

| Symbol        | Parameter                                        | Test conditions                                                                        | Min. | Typ.  | Max.      | Unit                           |
|---------------|--------------------------------------------------|----------------------------------------------------------------------------------------|------|-------|-----------|--------------------------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage                   | $I_D = 1\text{ mA}$ , $V_{GS} = 0$                                                     | 600  |       |           | V                              |
| $I_{DSS}$     | Zero gate voltage drain current ( $V_{GS} = 0$ ) | $V_{DS} = 600\text{ V}$<br>$V_{DS} = 600\text{ V}$ , $T_J=125\text{ }^{\circ}\text{C}$ |      |       | 1<br>10   | $\mu\text{A}$<br>$\mu\text{A}$ |
| $I_{GSS}$     | Gate body leakage current ( $V_{DS} = 0$ )       | $V_{GS} = \pm 25\text{ V}$                                                             |      |       | $\pm 100$ | nA                             |
| $V_{GS(th)}$  | Gate threshold voltage                           | $V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$                                     | 2    | 3     | 4         | V                              |
| $R_{DS(on)}$  | Static drain-source on-resistance                | $V_{GS} = 10\text{ V}$ , $I_D = 6.5\text{ A}$                                          |      | 0.260 | 0.285     | $\Omega$                       |

**Table 5. Dynamic**

| Symbol                              | Parameter                                                               | Test conditions                                                                            | Min. | Typ.            | Max. | Unit           |
|-------------------------------------|-------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|------|-----------------|------|----------------|
| $C_{iss}$<br>$C_{oss}$<br>$C_{rss}$ | Input capacitance<br>Output capacitance<br>Reverse transfer capacitance | $V_{DS} = 50\text{ V}$ , $f = 1\text{ MHz}$ ,<br>$V_{GS} = 0$                              | -    | 1000<br>60<br>3 | -    | pF<br>pF<br>pF |
| $C_{oss\text{ eq.}}^{(1)}$          | Output equivalent capacitance                                           | $V_{DS} = 0$ , to $480\text{ V}$ , $V_{GS}=0$                                              | -    | 225             | -    | pF             |
| $R_g$                               | Intrinsic resistance                                                    | $f=1\text{ MHz}$ open drain                                                                | -    | 3.5             | -    | $\Omega$       |
| $Q_g$<br>$Q_{gs}$<br>$Q_{gd}$       | Total gate charge<br>Gate-source charge<br>Gate-drain charge            | $V_{DD} = 480\text{ V}$ , $I_D = 13\text{ A}$<br>$V_{GS} = 10\text{ V}$<br>(see Figure 19) | -    | 35<br>6<br>20   | -    | nC<br>nC<br>nC |

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%  $V_{DS}$ .

**Table 6. Switching times**

| Symbol                                        | Parameter                                                           | Test conditions                                                                                                           | Min. | Typ.                 | Max. | Unit                 |
|-----------------------------------------------|---------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|------|----------------------|------|----------------------|
| $t_{d(on)}$<br>$t_r$<br>$t_{d(off)}$<br>$t_f$ | Turn-on delay time<br>Rise time<br>Turn-off delay time<br>Fall time | $V_{DD} = 300\text{ V}$ , $I_D = 6.5\text{ A}$ ,<br>$R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$<br>(see Figure 18) | -    | 12<br>15<br>55<br>25 | -    | ns<br>ns<br>ns<br>ns |

**Table 7. Source drain diode**

| Symbol          | Parameter                     | Test conditions                                                                                                                             | Min. | Typ. | Max. | Unit          |
|-----------------|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| $I_{SD}$        | Source-drain current          |                                                                                                                                             | -    |      | 13   | A             |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) |                                                                                                                                             | -    |      | 52   | A             |
| $V_{SD}^{(2)}$  | Forward on voltage            | $I_{SD} = 13\text{ A}$ , $V_{GS}=0$                                                                                                         | -    |      | 1.6  | V             |
| $t_{rr}$        | Reverse recovery time         | $I_{SD}=13\text{ A}$ , $di/dt=100\text{ A}/\mu\text{s}$ ,<br>$V_{DD}=60\text{ V}$<br>(see <a href="#">Figure 20</a> )                       | -    | 300  |      | ns            |
| $Q_{rr}$        | Reverse recovery charge       |                                                                                                                                             |      | 4.0  |      | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      |                                                                                                                                             |      | 25   |      | A             |
| $t_{rr}$        | Reverse recovery time         | $V_{DD}=60\text{ V}$<br>$di/dt=100\text{ A}/\mu\text{s}$ , $I_{SD}=13\text{ A}$<br>$T_j=150^\circ\text{C}$ (see <a href="#">Figure 20</a> ) | -    | 360  |      | ns            |
| $Q_{rr}$        | Reverse recovery charge       |                                                                                                                                             |      | 4.5  |      | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      |                                                                                                                                             |      | 25   |      | A             |

1. Pulse width limited by safe operating area

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

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for TO-220 and D<sup>2</sup>PAK

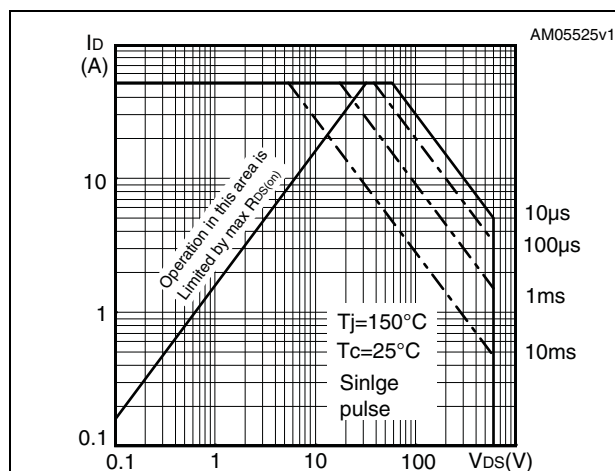


Figure 3. Thermal impedance for TO-220 and D<sup>2</sup>PAK

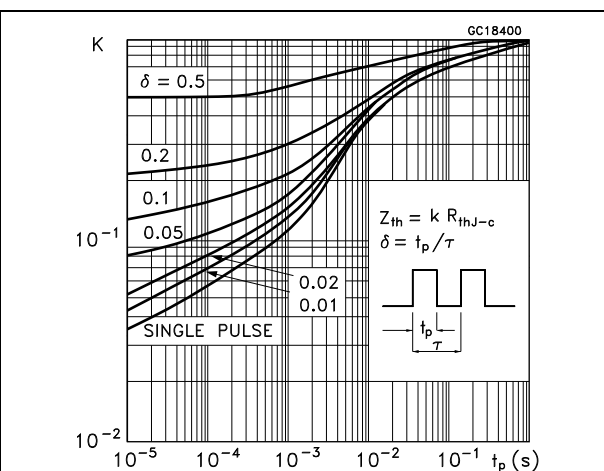


Figure 4. Safe operating area for TO-220FP

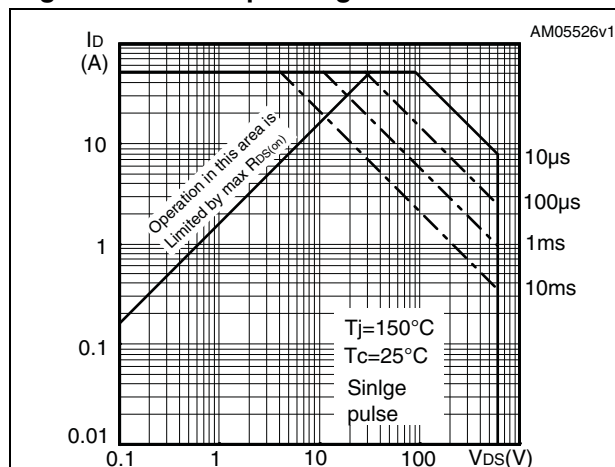


Figure 5. Thermal impedance for TO-220FP

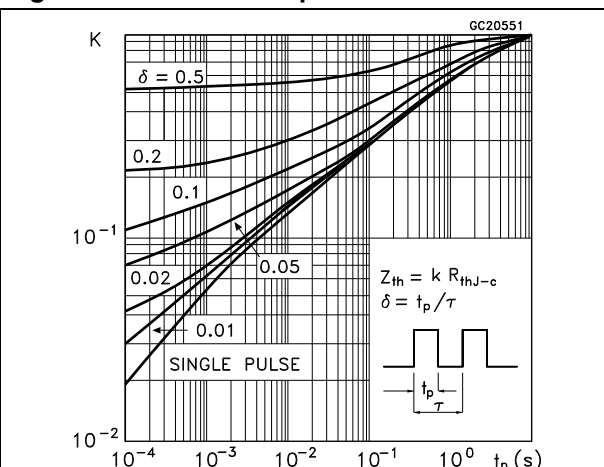


Figure 6. Safe operating area for TO-247

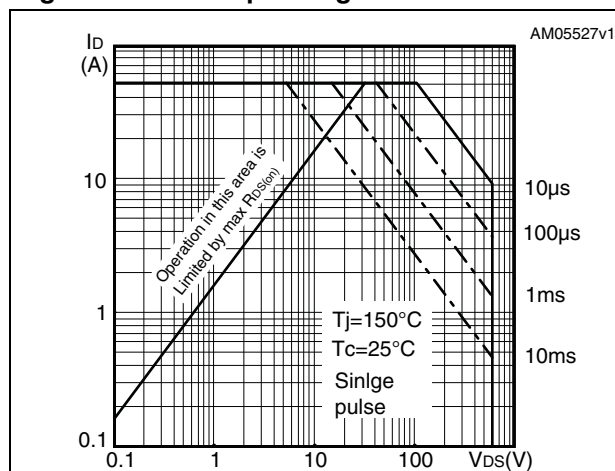


Figure 7. Thermal impedance for TO-247

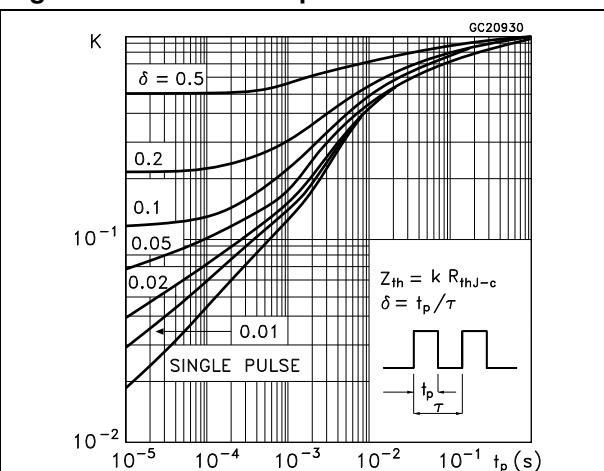


Figure 8. Output characteristics

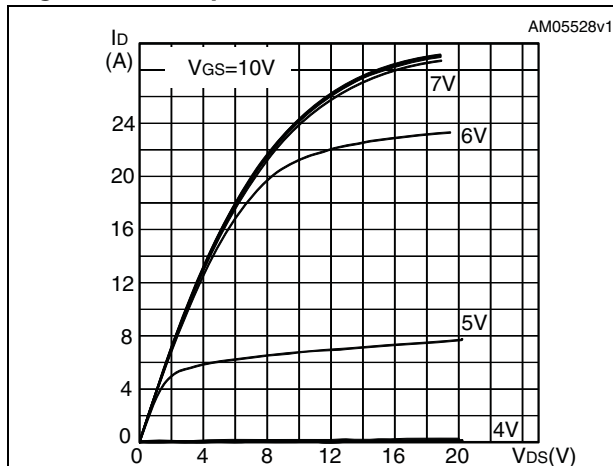


Figure 9. Transfer characteristics

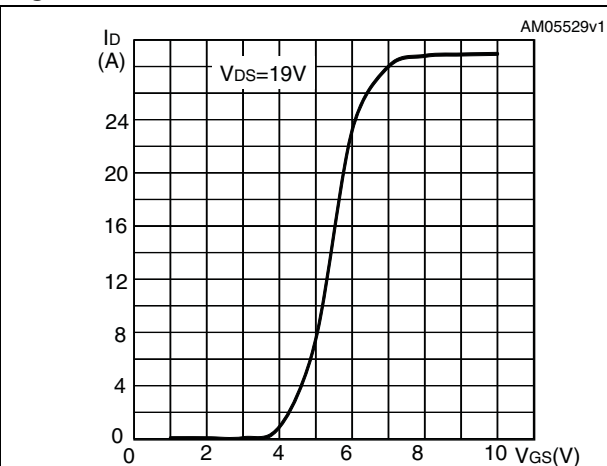


Figure 10. Static drain-source on resistance

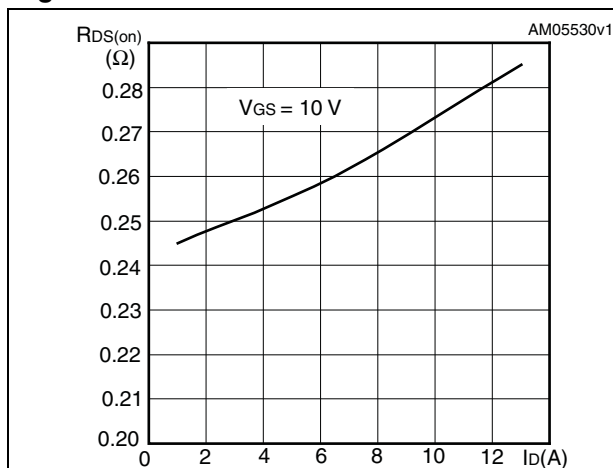


Figure 11. Gate charge vs gate-source voltage

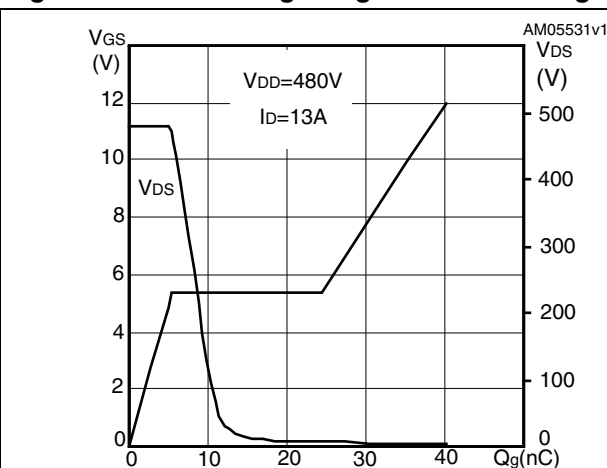


Figure 12. Capacitance variations

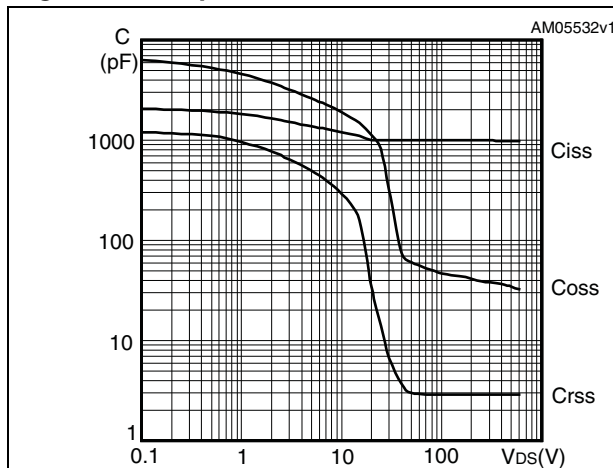


Figure 13. Output capacitance stored energy

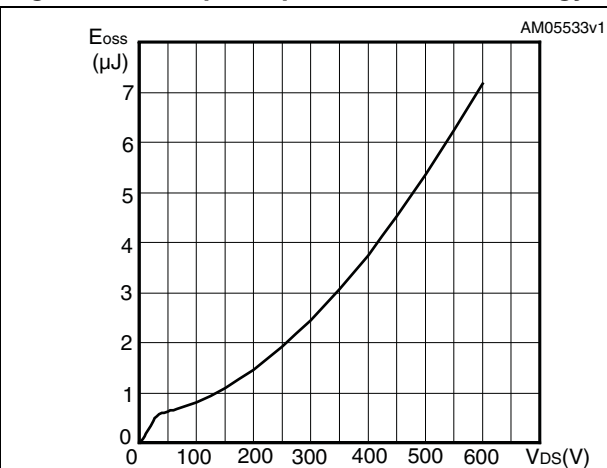


Figure 14. Normalized gate threshold voltage vs temperature

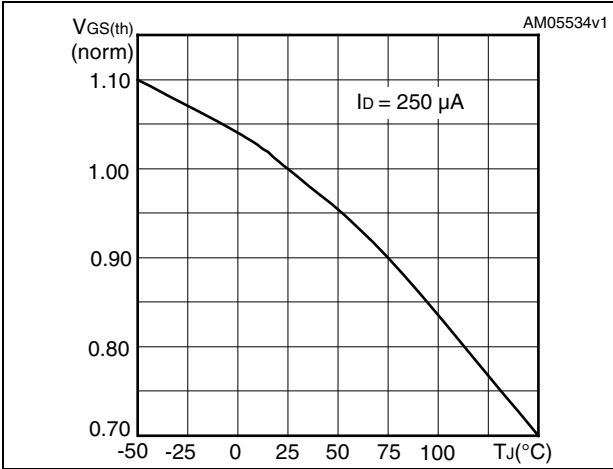


Figure 15. Normalized on resistance vs temperature

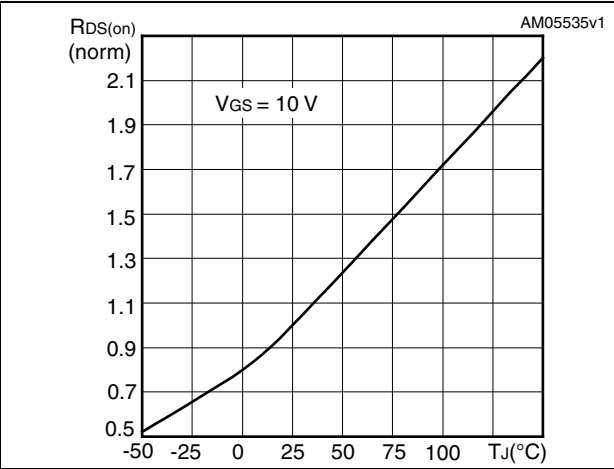


Figure 16. Normalized  $B_{V_{DSS}}$  vs temperature

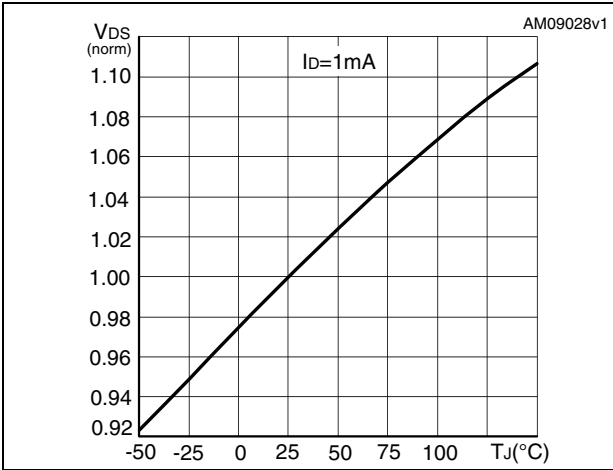
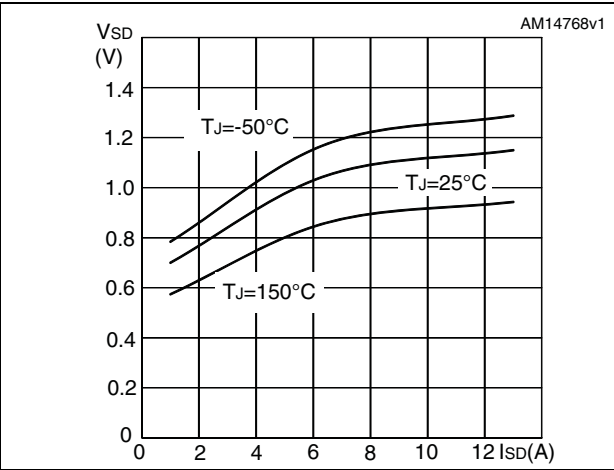


Figure 17. Source-drain diode forward vs temperature

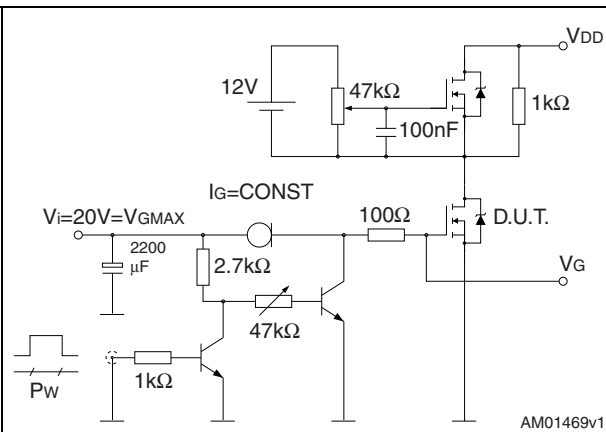


### 3 Test circuits

**Figure 18. Switching times test circuit for resistive load**



**Figure 19. Gate charge test circuit**



**Figure 20. Test circuit for inductive load switching and diode recovery times**



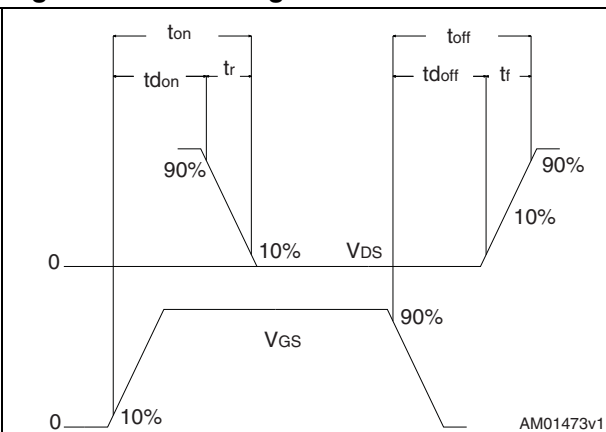
**Figure 21. Unclamped inductive load test circuit**



**Figure 22. Unclamped inductive waveform**



**Figure 23. Switching time waveform**

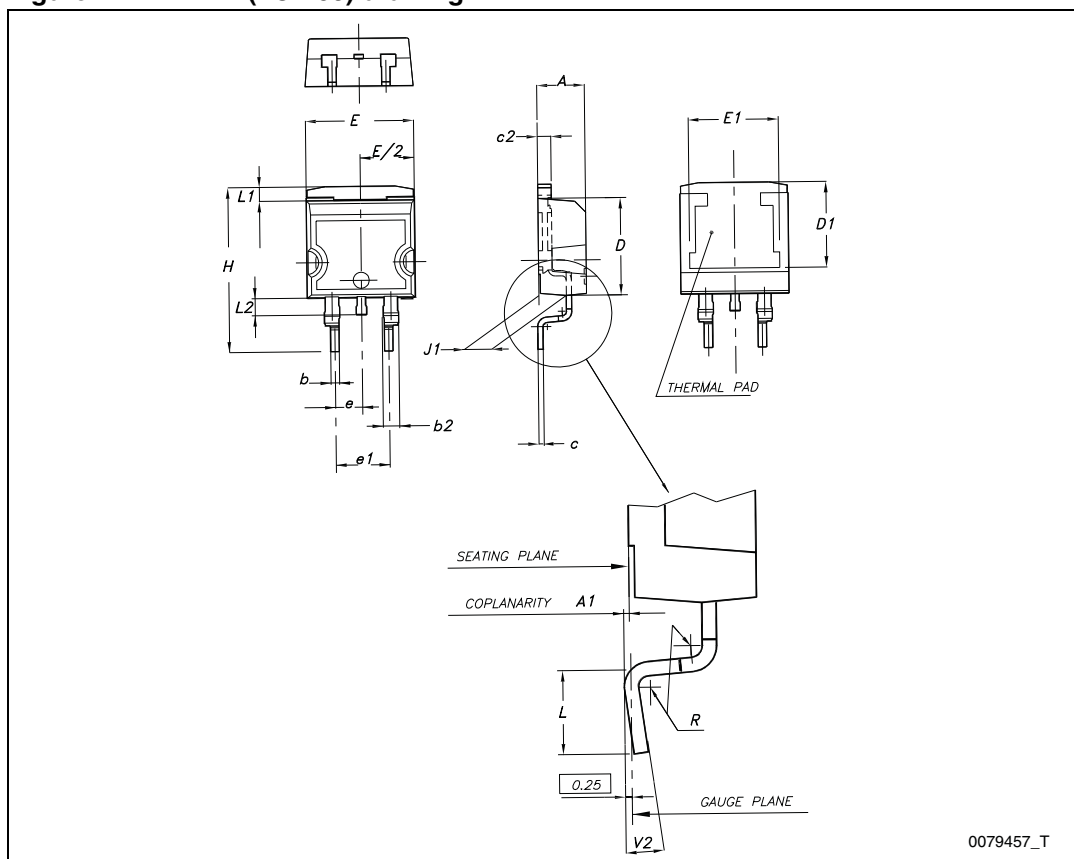
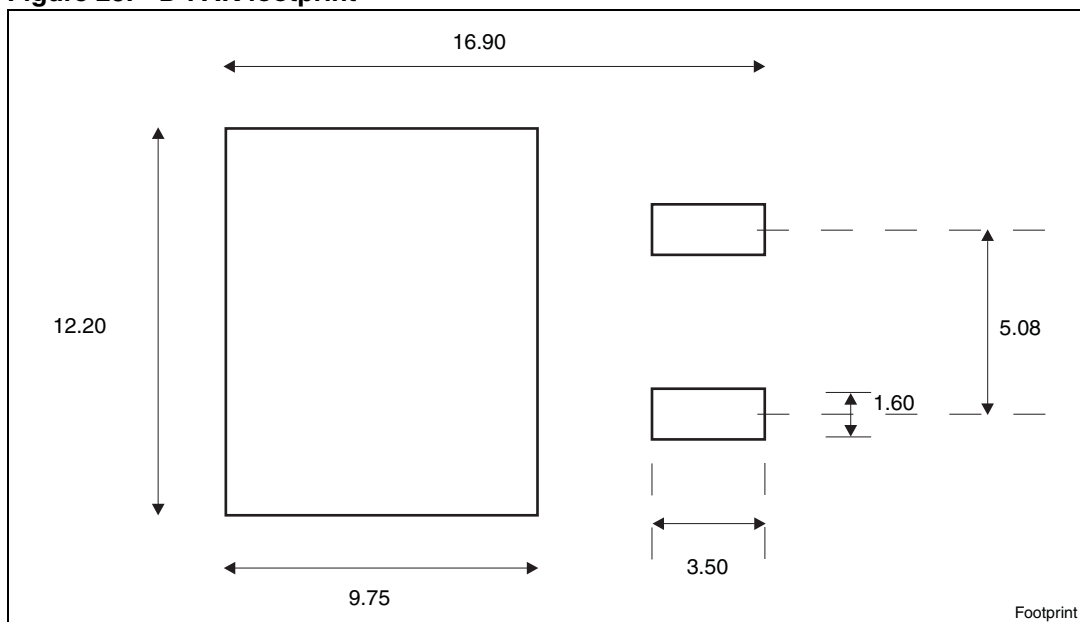


## 4 Package mechanical data

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.

**Table 8. D<sup>2</sup>PAK (TO-263) mechanical data**

| Dim. | mm   |      |       |
|------|------|------|-------|
|      | Min. | Typ. | Max.  |
| A    | 4.40 |      | 4.60  |
| A1   | 0.03 |      | 0.23  |
| b    | 0.70 |      | 0.93  |
| b2   | 1.14 |      | 1.70  |
| c    | 0.45 |      | 0.60  |
| c2   | 1.23 |      | 1.36  |
| D    | 8.95 |      | 9.35  |
| D1   | 7.50 |      |       |
| E    | 10   |      | 10.40 |
| E1   | 8.50 |      |       |
| e    |      | 2.54 |       |
| e1   | 4.88 |      | 5.28  |
| H    | 15   |      | 15.85 |
| J1   | 2.49 |      | 2.69  |
| L    | 2.29 |      | 2.79  |
| L1   | 1.27 |      | 1.40  |
| L2   | 1.30 |      | 1.75  |
| R    |      | 0.4  |       |
| V2   | 0°   |      | 8°    |

Figure 24. D<sup>2</sup>PAK (TO-263) drawingFigure 25. D<sup>2</sup>PAK footprint<sup>(a)</sup>

a. All dimension are in millimeters

Table 9. TO-220FP mechanical data

| Dim. | mm   |      |      |
|------|------|------|------|
|      | Min. | Typ. | Max. |
| A    | 4.4  |      | 4.6  |
| B    | 2.5  |      | 2.7  |
| D    | 2.5  |      | 2.75 |
| E    | 0.45 |      | 0.7  |
| F    | 0.75 |      | 1    |
| F1   | 1.15 |      | 1.70 |
| F2   | 1.15 |      | 1.70 |
| G    | 4.95 |      | 5.2  |
| G1   | 2.4  |      | 2.7  |
| H    | 10   |      | 10.4 |
| L2   |      | 16   |      |
| L3   | 28.6 |      | 30.6 |
| L4   | 9.8  |      | 10.6 |
| L5   | 2.9  |      | 3.6  |
| L6   | 15.9 |      | 16.4 |
| L7   | 9    |      | 9.3  |
| Dia  | 3    |      | 3.2  |

Figure 26. TO-220FP drawing

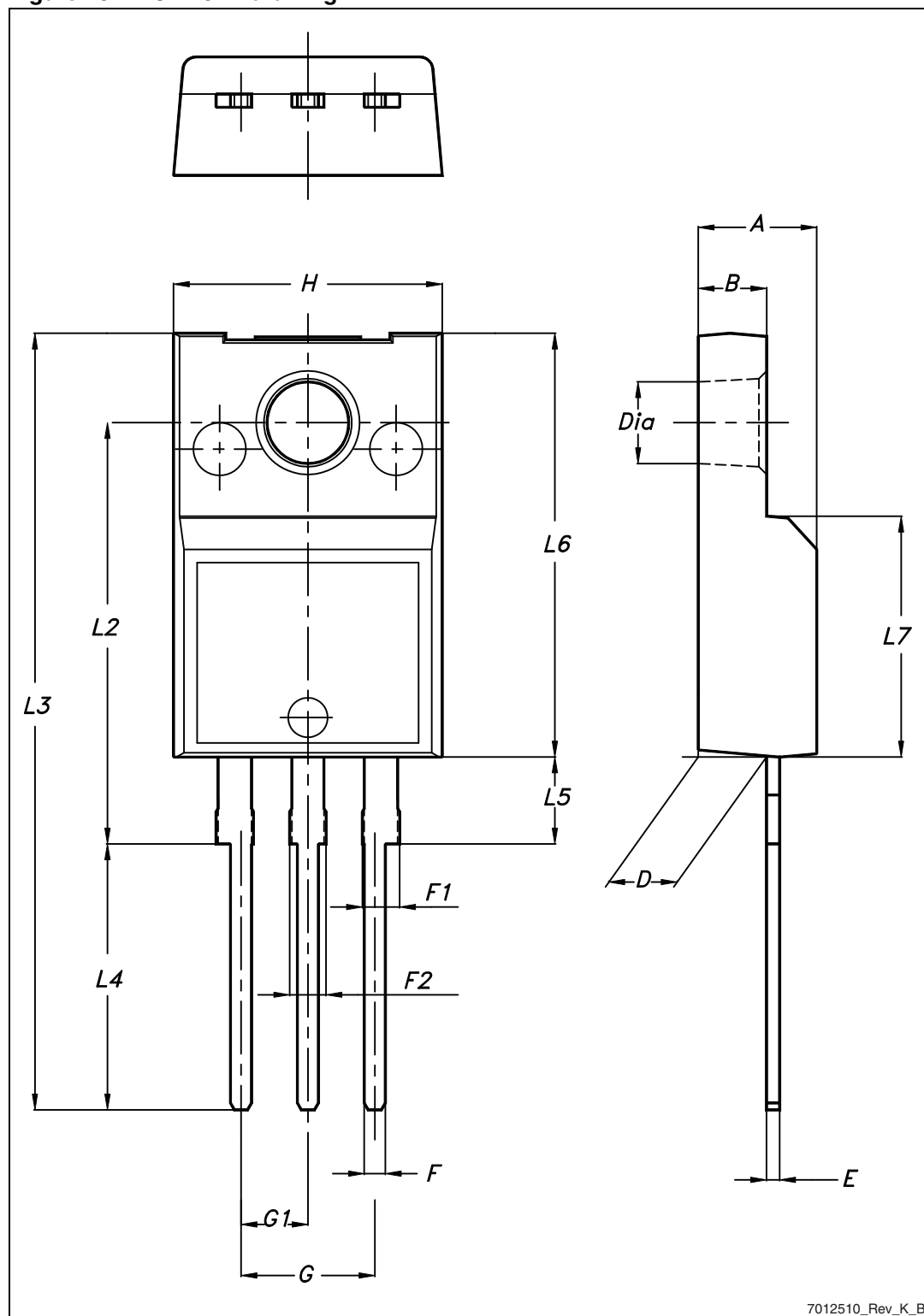


Table 10. TO-220 type A mechanical data

| Dim. | mm    |       |       |
|------|-------|-------|-------|
|      | Min.  | Typ.  | Max.  |
| A    | 4.40  |       | 4.60  |
| b    | 0.61  |       | 0.88  |
| b1   | 1.14  |       | 1.70  |
| c    | 0.48  |       | 0.70  |
| D    | 15.25 |       | 15.75 |
| D1   |       | 1.27  |       |
| E    | 10    |       | 10.40 |
| e    | 2.40  |       | 2.70  |
| e1   | 4.95  |       | 5.15  |
| F    | 1.23  |       | 1.32  |
| H1   | 6.20  |       | 6.60  |
| J1   | 2.40  |       | 2.72  |
| L    | 13    |       | 14    |
| L1   | 3.50  |       | 3.93  |
| L20  |       | 16.40 |       |
| L30  |       | 28.90 |       |
| ØP   | 3.75  |       | 3.85  |
| Q    | 2.65  |       | 2.95  |

Figure 27. TO-220 type A drawing

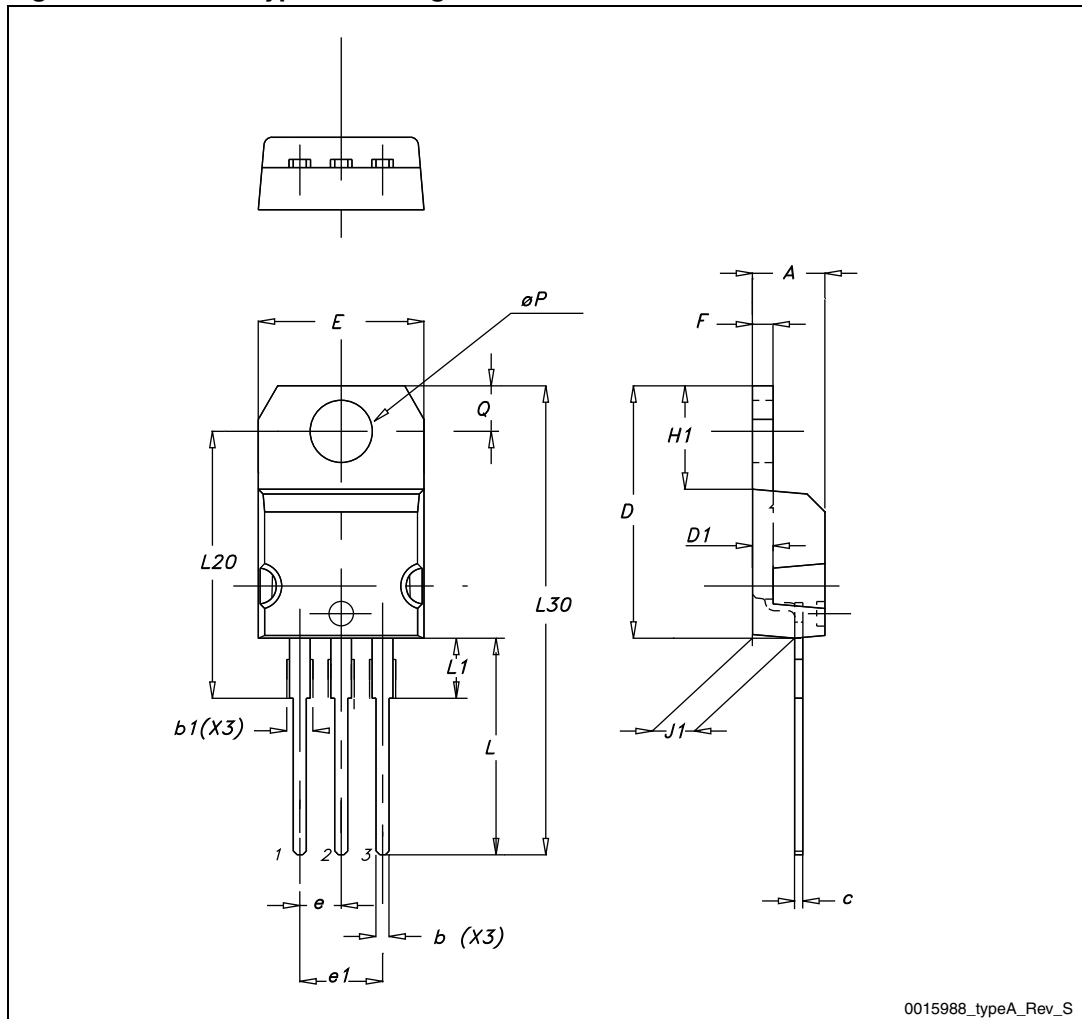
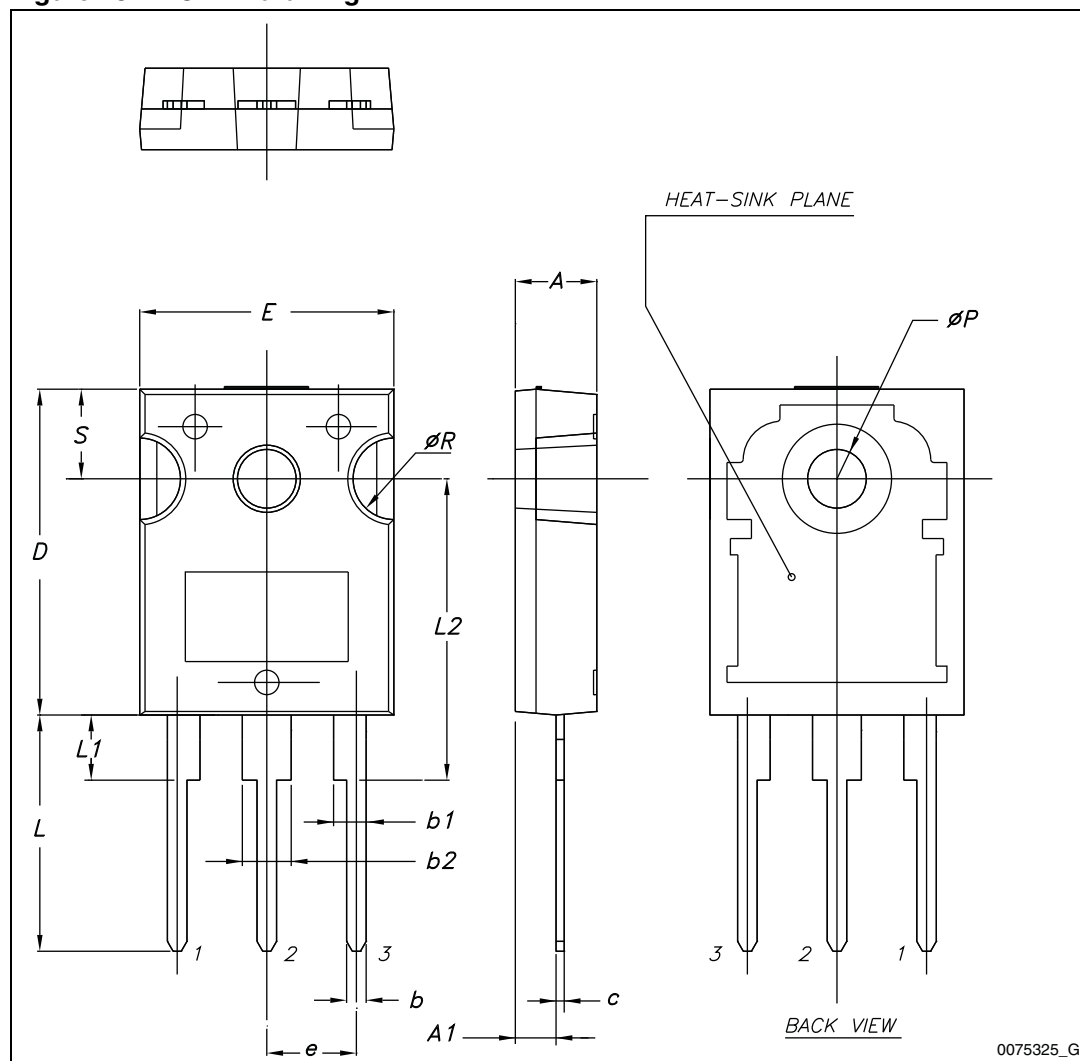


Table 11. TO-247 mechanical data

| Dim. | mm.   |       |       |
|------|-------|-------|-------|
|      | Min.  | Typ.  | Max.  |
| A    | 4.85  |       | 5.15  |
| A1   | 2.20  |       | 2.60  |
| b    | 1.0   |       | 1.40  |
| b1   | 2.0   |       | 2.40  |
| b2   | 3.0   |       | 3.40  |
| c    | 0.40  |       | 0.80  |
| D    | 19.85 |       | 20.15 |
| E    | 15.45 |       | 15.75 |
| e    | 5.30  | 5.45  | 5.60  |
| L    | 14.20 |       | 14.80 |
| L1   | 3.70  |       | 4.30  |
| L2   |       | 18.50 |       |
| ØP   | 3.55  |       | 3.65  |
| ØR   | 4.50  |       | 5.50  |
| S    | 5.30  | 5.50  | 5.70  |

Figure 28. TO-247 drawing



## 5 Packaging mechanical data

Table 12. D<sup>2</sup>PAK (TO-263) tape and reel mechanical data

| Tape |      |      | Reel     |      |      |
|------|------|------|----------|------|------|
| Dim. | mm   |      | Dim.     | mm   |      |
|      | Min. | Max. |          | Min. | Max. |
| A0   | 10.5 | 10.7 | A        |      | 330  |
| B0   | 15.7 | 15.9 | B        | 1.5  |      |
| D    | 1.5  | 1.6  | C        | 12.8 | 13.2 |
| D1   | 1.59 | 1.61 | D        | 20.2 |      |
| E    | 1.65 | 1.85 | G        | 24.4 | 26.4 |
| F    | 11.4 | 11.6 | N        | 100  |      |
| K0   | 4.8  | 5.0  | T        |      | 30.4 |
| P0   | 3.9  | 4.1  |          |      |      |
| P1   | 11.9 | 12.1 | Base qty |      | 1000 |
| P2   | 1.9  | 2.1  | Bulk qty |      | 1000 |
| R    | 50   |      |          |      |      |
| T    | 0.25 | 0.35 |          |      |      |
| W    | 23.7 | 24.3 |          |      |      |

Figure 29. Tape

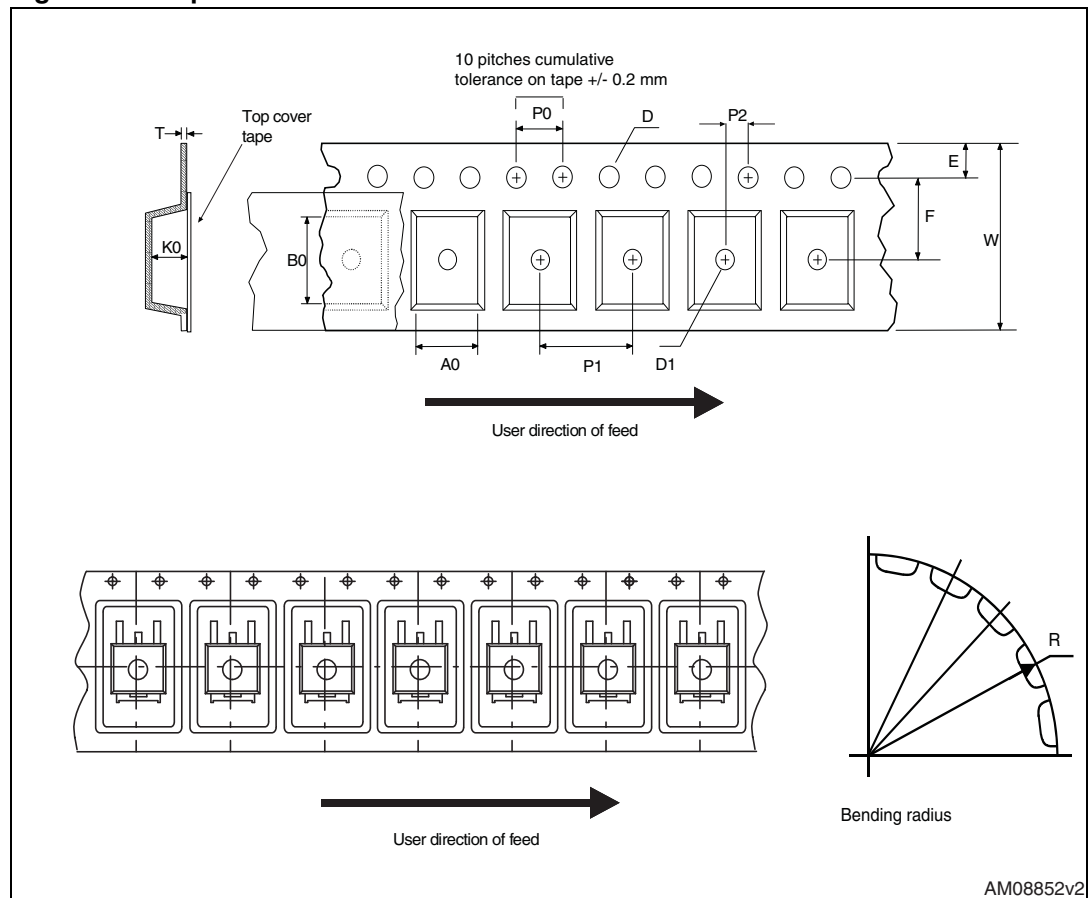
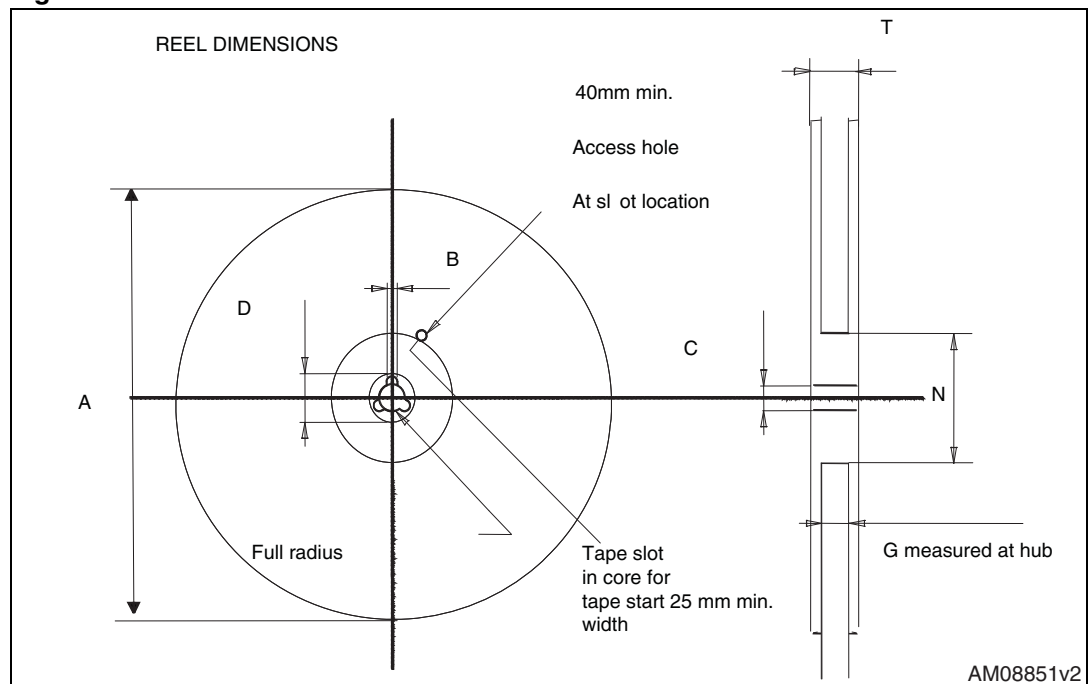


Figure 30. Reel



## 6 Revision history

**Table 13. Document revision history**

| Date        | Revision | Changes                                                                                                                                                                                                                                                                                                 |
|-------------|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 15-Jun-2009 | 1        | First release                                                                                                                                                                                                                                                                                           |
| 11-Nov-2009 | 2        | <ul style="list-style-type: none"><li>– Added <math>R_{DS(on)}</math> typical value</li><li>– Added new package, mechanical data: I<sup>2</sup>PAK</li><li>– Document status promoted from preliminary data to datasheet</li></ul>                                                                      |
| 06-Oct-2010 | 3        | Inserted new value in <a href="#">Table 5</a> .                                                                                                                                                                                                                                                         |
| 01-Oct-2012 | 4        | Updated title and description on the cover page.<br>Updated figures <a href="#">10</a> , <a href="#">11</a> , <a href="#">14</a> , <a href="#">15</a> and <a href="#">16</a> .<br>Updated <a href="#">Section 4: Package mechanical data</a> and <a href="#">Section 5: Packaging mechanical data</a> . |

**Please Read Carefully:**

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

**UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.**

**UNLESS EXPRESSLY APPROVED IN WRITING BY TWO AUTHORIZED ST REPRESENTATIVES, ST PRODUCTS ARE NOT RECOMMENDED, AUTHORIZED OR WARRANTED FOR USE IN MILITARY, AIR CRAFT, SPACE, LIFE SAVING, OR LIFE SUSTAINING APPLICATIONS, NOR IN PRODUCTS OR SYSTEMS WHERE FAILURE OR MALFUNCTION MAY RESULT IN PERSONAL INJURY, DEATH, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE. ST PRODUCTS WHICH ARE NOT SPECIFIED AS "AUTOMOTIVE GRADE" MAY ONLY BE USED IN AUTOMOTIVE APPLICATIONS AT USER'S OWN RISK.**

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

© 2012 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Philippines - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

[www.st.com](http://www.st.com)



## 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